Fisheries and Oceans Pêches et Océans

Canadian Stock Assessment Proceedings Series 99/25

Évaluation des stocks canadiens Séries des comptes rendus 99/25

Interaction Between Wild and Artificially Reared Striped Bass in the Maritime Provinces

Proceedings of the Diadromous Subcommittee Regional Advisory Process

December 9-11, 1998
Miramichi Room
Gulf Fisheries Centre
Moncton, N.B.

Convenors:
Rodney Bradford
David Cairns
Kimberley Robichaud-LeBlanc
John Ritter

Department of Fisheries and Oceans
Science Branch, Maritime Region
Gulf Fisheries Centre
343 Archibald Street
Moncton, N.B.
E1C 9B6
Canada

September 1999

Canada

Interaction Between Wild and Artificially Reared Striped Bass in the Maritime Provinces

Proceedings of the Diadromous Subcommittee
Regional Advisory Process

December 9-11, 1998
Miramichi Room
Gulf Fisheries Centre
Moncton, N.B.

Convenors:
Rodney Bradford
David Cairns
Kimberley Robichaud-LeBlanc
John Ritter

Department of Fisheries and Oceans
Science Branch, Maritime Region
Gulf Fisheries Centre
343 Archibald Street
Moncton, N.B.
E1C 9B6
Canada

TABLE OF CONTENTS

Table of Contents 3

Abstract / Résumé 4-5

Introduction 7

Peer Review – Rapporteur Reports 9

Appendix 1 – List of Participants 35

Appendix 2 – Invitation Letters

- Instruction Letter to Authors 37
- Instruction to Authors 39
- Letter to Panel Members 43
- Letter to Observers 45
- Observers 47
- Letter to Referees 51
- Notes of Guidance for Referees 53
- Review Panel 54

Appendix 3 – Meeting Schedule

- Agenda 56
- Outline 57

Appendix 4 – Meeting Remits 67

Appendix 5 – List of Documents Tabled

- Papers (Authors/ Rapporteurs and Referres) 68

Appendix 6 – List of Recommendations 70

ABSTRACT

Striped bass aquaculture and stocking programs are both widely practiced in the United States and have met with varying degrees of success depending on methodologies and husbandry practices. In contrast, the artificial rearing of striped bass in Canadian waters is a relatively new activity and not widespread. However, increased interest has been expressed in culture activity over the past decade as new information has become available on the potential for aquaculture development, enhancement of natural production in existing wild stocks and re-seeding estuaries that have lost native spawning runs.

While experience of salmon aquaculture in the Maritime Region and striped bass aquaculture in the US have shown the potential for interaction between cultured and wild fish, the magnitude of the potential effects between wild and culture striped bass in the Maritime Provinces is unclear. It therefore seemed appropriate to consider the implications of such activities on wild striped bass stocks before such activities proceed further.

In response to this situation, DFO held a special workshop under its Regional Assessment Process to evaluate the state of current knowledge pertaining to the status of wild striped bass and the possible consequences of interaction between wild and cultured striped bass as they would apply to the situation in the Maritime Provinces. The workshop also had the objective of documenting the protocols and regulatory controls which exist to protect the wild striped bass stocks of the Maritime Provinces as well as proposing measures which could minimize the risk of negative effects of cultured bass on wild striped bass. The Workshop took place from December 9-11, 1998 at the Gulf Fisheries Center in Moncton, New Brunswick with approximately 30 participants from government agencies, the aquaculture industry, conservation organizations, local and foreign universities.

Products from the Workshop include eight research documents summarizing both the available information on the local striped bass culture industry, the wild striped bass stocks and the science pertaining to the potential interaction between wild and cultured bass. In addition, a Stock Status Report was produced highlighting future management and research recommendations for immediate and long-term action.

102-06199/

RÉSUMÉ

Les programmes d'aquaculture et de stockage du bar rayé sont très répandus aux États-Unis, et sont couronnés d'un succès plus ou moins grand, selon les méthodologies et les pratiques d'élevage employées. Par contraste, l'élevage artificiel du bar rayé dans les eaux canadiennes est une activité relativement nouvelle et peu répandue. Cependant, au cours de la dernière décennie, on a commencé à s'intéresser de plus en plus aux activités de culture, en raison de l'information nouvelle transmise à propos du développement de l'aquaculture, de l'amélioration de la production naturelle chez les poissons sauvages et du réensemencement des estuaires où les montaisons d'origine avaient disparu.

Bien que l'expérience de l'aquaculture du saumon dans la région des Maritimes et du bar rayé aux États-Unis ont montré la possibilité d'une interaction entre les poissons sauvages et les poissons de culture, l'envergure des effets potentiels de l'interaction entre les bars rayés sauvages et de culture dans la région des Maritimes n'est pas claire. Il semblait donc approprié de considérer les implications de telles activités sur stocks de bars rayés sauvages avant de les laisser se poursuivre.

Pour réagir à la situation, le MPO a tenu un atelier spécial dans le cadre de son Processus consultatif régional pour évaluer l'état des connaissances actuelles sur la situation du bar rayé sauvage, et les conséquences possibles de son interaction avec le bar rayé de culture dans le contexte des provinces Maritimes. L'atelier avait aussi pour but de documenter les protocoles et la réglementation qui existent pour protéger les stocks de bars rayés sauvages des provinces Maritimes, et proposer des mesures qui minimiseraient le risque d'effets négatifs du bar de culture sur le bar rayé sauvage. L'atelier a eu lieu du 9 au 11 décembre 1998 au Centre des pêches du Golfe, à Moncton (Nouveau-Brunswick), et rassemblait une trentaine de participants représentant des organismes gouvernementaux, l'industrie de l'aquaculture, des organismes de conservation et des universités de la gestion et de l'étranger.

Parmi les produits de l'atelier, on compte huit documents de recherche résumant l'information disponible sur l'industrie locale de la culture du bar rayé, les stocks de bars rayés sauvages et l'étude de l'interaction potentielle entre le bar sauvage et le bar de culture. On a aussi produit un rapport sur la situation des stocks dans lequel on formule des recommandations sur les mesures à prendre à court et à moyen terme en matière de gestion et de recherche.

INTRODUCTION

This report provides records of the peer review meeting for the evaluation of the state of current knowledge regarding the status of wild striped bass stocks and the possible consequences of interactions (changes in genetic composition, introduction of diseases and parasites, and harmful ecological effects) between wild and cultured striped bass in the Maritime Provinces. This report also serves to document the protocols and regulatory controls which exist to protect the wild striped bass stocks of the Maritime Provinces as well as proposing measures which could minimize the risk of negative effects of cultured bass on wild striped bass (see Appendix 4 for remit of the meeting). The subcommittee convening the meeting consisted of the following individuals from DFO Science: John Ritter, Rodney Bradford, David Cairns, and Kimberly Robichaud-LeBlanc. The meeting was chaired by David Meerburg, the Policy Advisor for Anadromous and Catadromous Fishes in DFO, Ottawa.

The Regional Assessment Workshop took place from December 9 to December 11, 1998 at the Gulf Fisheries Centre, Moncton, New Brunswick. The review panel (authors, referees and invited experts) consisted of 20 members from DFO Science (Maritimes and Headquarters), DFO Fisheries Management, local universities (Dalhousie University, University of New Brunswick, University of Prince Edward Island), universities in the US (University of Maryland and East Carolina University), local fish hatcheries (Cardigan Fish Hatchery and Miramichi Fish Hatchery), and the private sector (Atlantic Veterinary College, the New Brunswick Wildlife Federation and the Miramichi Watershed Management Committee). See Appendix 1, for the list of participants and Appendix 2 for the letter and instructions to authors, which includes a review panel list on page 54. Participants were selected to bring to the review a wide range of knowledge and expertise pertaining to the particular issues. In addition to panel members, invitations were also extended to interested groups to attend as observers. The workshop was also opened to the general public. An additional 9 observers from the striped bass angling interests, a local national park and other government departments (Nova Scotia, and Prince Edward Island) attended and participated in the review process. The letters of invitation to panel members and observers, as well as the observer invitation list are all included in Appendix 2.

Eight working papers on topics pertaining to the status of wild stocks and/or the interaction between wild and cultured striped bass in the Maritime Provinces were peer reviewed during the three-day session (see Agenda in Appendix 3). Thirteen referees contributed to the review on the eight working papers (Appendix 5). Each paper was formally reviewed by at least one referee, but was also opened-up to questioning and comments from all participants in attendance.

The comments and concerns, with the author's responses, are summarized in the rapporteur reports prepared for each of the eight working papers presented and are detailed in Peer Review (pages 6-34) of this report. In addition to the general recommendations outlined in the resulting Stock Status Report, these same reports present the detailed research recommendations and management considerations for immediate and long-term action in each specific case (Appendix 6).

The remit for the meeting was:

- Are artificially-reared striped bass interacting with wild striped bass in the Maritimes Region?
- If so, what are the potential impacts on the wild striped bass stocks in the Maritimes Region?
- What should be done to eliminate or minimize these impacts?

PEER REVIEW – RAPPORTEUR REPORTS

STRIPED BASS CULTURE IN EASTERN CANADA: PAST, PRESENT AND FUTURE

Working Paper(s): WP 98-101 – Paper 1

Author: Cairns, David; Robichaud-LeBlanc, Kim; Bradford, Rod; Peterson, Richard; and Angus, Randy

Referees: Hogans, Bill and Groman, David

Rapporteur: Courtenay, Simon

Summary/Abstract:
Striped bass (*Morone saxatilis*) culture in eastern Canada began with experimental programs at the St. Andrews Biological Station in the late 1980s. Small commercial aquaculture ventures have been initiated in southwestern New Brunswick, mainland Nova Scotia, Cape Breton Island, Prince Edward Island, and eastern Quebec. Several of these operations have ceased bass culture, and those that continue to raise bass do so at a small scale with limited commercial sales. The St. Andrews Biological Station has ended its striped bass program, but research and development work continues at the Huntsman Marine Sciences Centerre and the Nova Scotia Agricultural College. Pilot culture projects also continue at divested federal hatcheries in Cardigan PEI and Miramichi NB. To date, major capital investment, appropriate sites and equipment, and expert husbandry have not been brought together in a single striped bass venture in eastern Canada. Reliable information on striped bass transfers and escapes is necessary for development of strains suitable for aquaculture, to evaluate potential alteration of the genetic make-up of wild stocks through interbreeding of escapees and wild fish, and to trace potential routes of disease transmission. It is recommended that a system be established to record and archive such information for eastern Canada.

Issues/Concerns: (Including response)

1. The only major issue/concern was the response of industry to a mandatory reporting structure.

2.Consensus was that transfers/introductions/escapes should be entered into an electronic database accessible to, and used by provincial and federal departments.

D. Gromans
- great detective work
- - we need a record-keeping system for transfers and escapes
- concern about perception of industry of a "big-brother" approach.

D. Cairns
- setting up such a system would have to be done at DFO national level
- if the industry grows, proprietal concerns will need attention
- sales are all recorded by DFO but these are confidential. Privacy of operators must be respected but DFO needs this information for management

D. Gromans
- need federal/provincial coordination of transfers/introductions
- this is common to all species - trout, salmon etc. - hence those industries would have to agree too before setting this precedent with striped bass

D. Cairns
- let's await the rest of this RAP to see if this recommendation survives

J. Ritter
- re. Reporting escapees and diseases - there is a section in the report dealing with this

D. Gromans
- yes but this is not done by industry now – add a schematic to show steps in the process?

B. Jessop
- let's try this recording system with striped bass before salmonids - as a pilot project – because the striped bass community is so much smaller than the salmonid community.

D. Gromans
- yes, but the system would have to be voluntary. The Canadian Aquaculture Alliance would resist it being regulated.

D. Meerburg
- Dave (Cairns) - did you check records of the Introductions & Transfers Committees in preparing this MS?

D. Cairns
- No, but I have the impression that that no long-term, systematic records are kept.

B. Jessop
- Actually there are such records for Scotia/Fundy region at least

G. Stevens
- there are log records on computer files for 1996 on

G. Stevens
- to Andrew Bagnall - aren't operators required to report escapes annually?

A. Bagnall
- No. Sales only.

D. Meerburg
- Can we add a paragraph to this paper on techniques of striped bass culture - e.g., sea-cages, ponds etc. (Dick Peterson gave a summary on rearing conditions for eggs to larvae to juveniles to yearlings including salinity, temperature, food etc. Only a few thousand striped bass per year have been produced to date in the Canadian Maritimes – most from the Two Rivers Hatchery on the Stewiake River which were sold in Halifax.)

D. Gromans
- the big fish market to break into is Toronto. Are any Morone hybrids grown in Canada?

D. Peterson
- No.

S. Courtenay
- a supermarket in Moncton was recently selling Morones that they said were locally produced hybrids. I have a couple of these in the freezer if anyone can confirm their species.

D. Meerburg
- is there any provincial licensing for producing striped bass?

Response
- Yes, the Two Rivers Hatchery is licensed by NS.

S. Courtenay
- what does the Two Rivers Hatchery do to ensure that it does not spread disease to the Stewiake River into which it discharges its flow-through water?

D. Peterson
Nothing but there have not been major disease problems there to date. There were some parasite problems and some gill problems but no pathogens were successfully cultured in these instances.

Consensus:

- **Research Recommendation**

1. Reliable information on striped bass transfers and escapes is necessary for development of strains suitable for aquaculture, to evaluate potential alteration of the genetic make-up of

wild stocks through interbreeding of escapees and wild fish, and to trace potential routes of disease transmission. It is recommended that a system be established to record and archive such information for eastern Canada as a pilot before implementing it with salmonids.

- **Management Consideration**

1. A data-gathering system be put in place that systematically records all transfers of striped bass genetic material, including milt, eggs, larvae, juveniles, and adults, within eastern Canada and between eastern Canada and other areas. The system should record the dates, numbers, life stages, health status, providing facilities, genetic origins, and destinations of transfers. Transfers between culture and the wild state, both intentional and accidental (escapes) would be considered transfers.

2. This system should record data in permanent archives, in a manner analogous to fishery landing statistics. The system should have clear rules regarding confidentiality and public disclosure of data.

3. If some part of this system is operated by provincial authorities, then data gathering and archiving should be set up under common protocols so that inter-provincial transfers, and releases or escapes of fish that might later cross provincial boundaries, can be readily traced.

STATUS OF STRIPED BASS *(MORONE SAXATILIS)* IN THE GULF OF ST. LAWRENCE IN 1998

Working Paper(s): WP98-102 – Paper 2

Author: Bradford, Rod; Chaput, Gérald; Douglas, Scott; and Hayward, John

Referees: Jessop, Brian; and Cairns, David

Rapporteur: Peterson, Dick

Summary/Abstract:
Spawner abundance was low in 1998, and will continue to be low through the year 2000, due to decline of the strong 1991 year class and weak recruitment from the 1992-95 year classes. The 1998 year class is small, but over–winter survival may be good due to large average size. Losses due to hook and release and First Nation food fisheries can no longer be justified.

Issues/Concerns: (Including response)

J. Hutchings:
- The assumption seems to be that bass don't spawn in the SW Miramichi - do they? (Response) A few eggs have been found at the confluence of the Barnaby and NW. There thus may be some spawning in the SW. Robinson: We captured young of the year 1-1.5 cm long at the mouth of the Barnaby. Do you see ripe fish there? (Response) Yes, but not in large numbers. Most are males and the catch rate is low. There may possibly be some later spawning, resulting in some very small young of the year fish. However fish gonads enlarge remarkably in late summer.

R. Harrell:
- You can have pre–vitellogenic eggs that are quite large due to lipid accumulation, and you can have running ripe males in the fall. Doesn't imply that fall spawning has occurred.

G. Klassen:
- I would like to see the methods for population estimates placed in the context of comparison with estimates elsewhere on the Atlantic coast. Meerburg: also in perspective with historic numbers. (Response) I would like to look for climactic forcing eventually, I think the dynamics are currently governed mostly by human activities.

G. Klassen:
- What do you see during spawning? (Response) A lot of splashing – usually on a hot day. In the 80's Hogans reported "spawning" activity in the Kouchibouguac when spawning shouldn't have been occurring. The activity may not have been spawning, or these fish may

not have gotten back to the Miramichi at the right time. S. Courtenay: the salinity in this

area is never less than 15 ppt, do any studies indicate this type of activity is solely related to spawning? R. Harrell: feeding frenzies can emulate spawning activity if a large school is present.

S. Courtenay:
- How does one deal with the Big Cove fishery? Lutzac: Close the fishery completely and enforce it. There is sufficient data to shut down all fishing activity, including hook and release and the native fishery. Chaput: What exactly are we talking about here? (Response) angling; we can't stop the gaspereau fishery by - catch.

F. Wheaton:
- Are you discounting winter mortality for the decrease in '98 spawning numbers? (Response) There are no reports (or records) of large fish dying off. It is more probable that they are being removed. Catchability seems to increase when populations are low.

D. Groman:
- Are emaciated fish checked for pathogens? (Response) No.

J. Ritter:
- Two comments, to stop the native fishery, you have to stop all directed activities. Secondly, it appears that the southern Gulf of St. Lawrence depends upon one spawning area, and there are development activities near that area. Can we classify this area as a sensitive area that required special protection up front? (Response) I would like to see the risk of such developed activities assessed.

S. Courtenay:
- The area should be a protected area. The Oceans Act might be useful in this regard. Could there be a recommendation from this group? D. Meerburg: more work is required on this – would it constitute a "marine" area?

Consensus:

While no consensus was sought, there was general agreement that (1) the current low numbers of spawners required a general curtailment of exploitation. (2) the apparent sole spawning area in the southern Gulf requires protection.

Research Recommendation

1. Again there were no specific recommendations, but more thorough investigation of other possible spawning areas seemed appropriate. (debated elsewhere).

UPDATE ON THE STATUS OF STRIPED BASS *(MORONE SAXATILIS)* IN EASTERN CANADA IN 1998

Working Paper(s): WP98-103 – Paper 3

Author: Bradford, Rod; Cairns, David; and Jessop, Brian

Referees: Wheaton, Fred; and Robichuad-LeBlanc, Kimberly

Rapporteur: Chaput, Gérald

Summary/Abstract:
Five self-sustaining populations of striped bass are known to have existed within Canadian waters. Four of these occurred in the Maritimes Region, with documented spawning activity on the Miramichi and Saint John rivers, New Brunswick, and the Shubenacadie and Annapolis rivers, Nova Scotia. The fifth population, now extirpated, spawned in the St. Lawrence River, Quebec. Strong evidence indicates that of the original five populations only the Miramichi and Shubenacadie populations remain as viable representatives of this species at the northern limit of its natural spawning range. Miramichi and Shubenacadie fish are now the sole known representatives of the species within the Gulf of St. Lawrence and Bay of Fundy bio-geographic regions respectively. There is no empirical evidence to support claims that self-sustaining populations of striped bass occur elsewhere in the southern Gulf of St. Lawrence, either along the mainland shore or in Prince Edward Island waters. Biological, ecological, and habitat factors contributing to uncertainty in striped bass management in the Maritimes region are discussed.

Issues/Concerns: (Including response) (Kim Robichaud-Leblanc, Fred Wheaton)

1. Page 4: references for documented self-sustaining populations, and how are they documented.

2. Provide a summary table with rivers, spawning status confirmed, status, extirpation etc. to facilitate understanding of all the information presented.

3. If the NW Miramichi is the principal spawning area, then something should be done to protect this area.

4. Clarify, based on evidence, that there are currently only two populations but there may still exist other populations and these are worthy of research.

5. Research recommendations in isolation indicate that nothing is proposed for the NW

Miramichi population. Reference should be made to previous assessment document.

6. What are the dynamics of water drawdown at Mactaquac – we need to distinguish between short-term disruption of spawning area (construction) versus long-term disruption from water regulation/discharge. Do conditions which led to extirpation still exist? Historically located spawning grounds were within 10 km of Mactaquac dam.

7. Emphasize the need to undertake studies to address why bass are still being lost despite closures of many fisheries.

8. J. Hutchings
   - What confidence can we attribute to the 5000 female conservation requirement for Miramichi? Indicators of response in the juvenile index suggests that it is an appropriate interim value.

9. D. Meerburg
   - It would be useful to include predator/prey information along with the summary of life history characteristics.

10. R. Rulifson
    - Winter refuge cannot be generalized as being in the vicinity of the salt wedge for all striped bass populations, but it appears so for southern Gulf.

11. R. Rulifson
    - There are three migrations (spring downstream, spawning upstream, fall upstream) and all these should be considered.

12. R. Rulifson
    - At reduced stock levels, spawning concentration is in Miramichi but at higher stock levels, spawning may extend into other estuaries. Response: tagging programs are taking this into account now.

13. B. Jessop
    - There are additional spawning sites in the Saint John, particularly Belle Isle Creek.

Consensus:

- **Research Recommendation**

1. Resolve stock status of striped bass on Prince Edward Island.
2. Conduct stock assessment of the Shubenacadie River striped bass.
3. Address Nictaux River hydroelectric generation and pH depression on Annapolis River.

4. Study dynamics of water drawdown at Mactaquac and impact on spawning habitat.

- **Management Consideration**

1. Two of the three known extirpations of striped bass from Canadian waters have occurred in the Maritimes. The overall loss of production from these extirpations is not known because abundance estimates have only been obtained for one stock (Miramichi). It is not known if losses represent a significant loss of genetic diversity.
2. Until demonstrated otherwise, striped bass management at the regional level should proceed on the basis that there are only two self-sustaining populations in the Maritimes.
3. Sufficient information is available for Miramichi River bass to assist in the control of by-catch in commercial fisheries.
4. Sufficient information has been acquired about spawning, rearing and over-winter habitat of Miramichi striped bass to be included in terms of reference for environmental impact assessments.

GENETIC INVESTIGATIONS ON STRIPED BASS IN THE MARITIME PROVINCES

Working Paper(s): WP98-104 – Paper 4

Author: Robinson, Mike; and Courtenay, Simon

Referees: Peterson, Richard; and Bradford, Rodney

Rapporteur: Hutchings, Jeff

Summary/Abstract:
The paper provides a broad description of the various techniques available to analyze genetic variation among fish populations. Summarizing analyses of genetic variation in striped bass, the authors report the following observations on striped bass populations in eastern Canada. Based on mitochondrial DNA (mtDNA) analyses, striped bass from the Bay of Fundy and southern Gulf of St. Lawrence are distinguishable as separate populations. Juvenile bass from two neighbouring rivers in the southern Gulf (Miramichi and Tabusintac) cannot be distinguished by mtDNA analysis. Striped bass in the Saint John River are primarily of American origin. Ongoing analyses of microsatellite DNA be used to test the null hypothesis that young-of-the-year bass collected in the Kouchibouguac and Richibucto are genetically indistinguishable from those collected in the Miramichi River.

Issues/Concerns: (Including response)

1. Referee 1 – Dick Peterson (DP):

The manuscript was clear and provided a good overview of genetic techniques to analyze genetic variation among populations. Specific concerns/comments follow:

1. Abstract – 2nd sentence; expressed worry about the implications; modify sentence?
2. Introduction – halfway down page, the questions being asked are not very clear; specify the questions more clearly.
3. To what degree have these genetic studies provided us with information that tagging studies didn't provide us with? How would more sophisticated genetic studies provide us with more information? Response: Reference made to brook trout studies in northern Quebec; tagging & mtDNA studies suggested one situation regarding population structure while microsatellite work suggested another; thus, the latter can be used as an evaluation technique
4. There is no indication of the sample sizes used in the genetic analyses. Response: The

sample size required depends on the genetic analyses performed. There is a need for more genetic work on the Saint John and Annapolis populations. Perhaps this should be put into the Recommendations.

5. Please define "mixture model"?
6. If more than 50% are of Saint John River fish are of American origin, how can you make the leap that *all* Saint John fish are of American origin. Response (Simon Courtenay-SC): Actually, up to 97% of the fish in the Saint John River are of American origin. This discrepancy needs to be changed in the text.

2. Referee 2 -- Rod Bradford (RB):

For this manuscript to be suitable as a Research Document, there needs to be a number of changes to the manuscript: a) include more references in the Introduction, b) link your Research Document with the other manuscripts that have been presented, c) the research and management issues should be placed in a separate section, d) the title should reflect the fact that the MS includes important information on young of the year fish and their distribution.

1. Abstract: Strike the word some from the reference to migration by young of the year. Response: I would prefer to leave this qualifier in there. We don't wish to imply that young of the year migrate all over the place. Possible solution: simply state that these fish are migratory, and leave it at that; or simply state that a portion of young of the year appear to leave their natal estuaries.
2. Introduction: There is an implication that it isn't always possible to assess stock structure by tagging/bycatch studies. The referee disagrees, arguing that these studies are only limited by the amount of resources allocated to them. Response: Genetic studies may be more financially viable. There was a suggestion to strike this part of the paragraph.
3. Regarding mtDNA in the second paragraph: Are the authors suggesting that mtDNA studies are not useful? Response: No, but nuclear DNA studies have greater resolution.
4. The section on junk DNA was informative. But add references that reveal how people are able to identify non-coding regions.
5. Section 4, page 15: Regarding the 1997/98 studies. If you show that there is likely one population in southern Gulf, how can you estimate genetic variability from just one out-group? Response: Within a given group, using 9 loci, you can get a very good idea of how genetically diverse a population is.
6. Alternatively, are you looking for a genetic signal as to how far bass are moving? What is the issue here. Response: No, this is not really the issue here.
7. Discussion: Regarding the Research Recommendations - Remark upon the Hillsborough River. Also, indicate that you have primers and polymorphic loci available for striped bass that can be used to address questions of population structure and migration in the future.
8. Page 17: What do you mean by "support striped bass spawning"? How much weight should be put on ichthyoplankton sampling as an indicator of spawning events? If this is

used to mean support, caution should be exercised. Response: The issue is in which rivers do we see striped bass spawning. This relates to the question of the degree to which these other populations may be contributing to the productivity of striped bass in southern Gulf.

9. Second last sentence: The referee disagrees with the suggestion that genetic studies are paramount to future studies.

Consensus:

- **Research Recommendations**

1. Ichthyoplankton and beach seine surveys should be conducted to quantify the abundance of striped bass eggs and larvae in those rivers in the southern Gulf and Bay of Fundy suspected of containing habitat suitable for striped bass reproduction and rearing of juveniles.
2. Nuclear DNA studies should be continued to assess population differentiation among known and suspected striped bass populations in eastern Canada.
3. Nuclear DNA data should be coupled with mtDNA restriction fragment length pattern (RFLP) data to assess the validity of conclusions based on previous mtDNA studies.
4. Genetic analyses should be conducted to quantify the temporal stability of genetic variation in known or suspected striped bass populations.
5. Undertake genetic studies to study the phylogeography of striped bass.

Others

Greg Klassen (GK):

- I'm really upset about the statement regarding the contributions of genetics to this work. From a bio-diversity perspective, the real contribution of genetic work in the long run is the archiving of data for future research. Response: Simon Courtenay (SC) – Whole samples should be archived as well. GK: The value of archiving data is that these data can be used for future stock identification work and to provide information on the temporal stability of genetic variation.

- What are the differences between DNA fingerprinting and the microsatellite DNA analyses you presented? Response by Mike Robinson (MR): No real substantive difference.

Reginal Harrell (RH):

- Be cautious of using microsatellite DNA to delineate population structure; you need to be careful of just what you are sampling.

Gerald Chaput (GC):
- What constitutes a population? Response by Mike Robinson: A population is one discrete, reproductive unit. Further analyses might help to delineate this. Corrective Action: Provide a definition for population and stock in the Introduction.

Gerald Chaput (GC):
- I am concerned that there are limitations on the conclusions that have been drawn that are related to the sampling protocol. Are you certain that the sampling regime was truly random, etc.? In your Introduction, specify the sampling protocol and the assumptions that are implicit in the genetic analyses.

Brian Jessop (BJ):
- In the Introduction, the term "largely unconfirmed" should be modified; there is no question as to where striped bass historically spawn. Perhaps this should be toned down for the Bay of Fundy but not necessarily for the southern Gulf. Solution – Split into two sentences.

- Also, on page 17, which rivers in the Gulf and Bay of Fundy support striped bass spawning? We know a fair bit about present spawning – separate the historical and contemporary reports of spawning events.

Jeff Hutchings (JH):
- To what degree would annual differences in the mixing of stocks in specific rivers (e.g., Saint John and Shubenacadie) affect conclusions drawn based on genetic analyses? Response by SC: In fact, the previous work suggested 1 and 7% input from American fish in Shubenacadie and a 60 to 97% range in contribution of American fish to the Saint John River. Underscores the importance of sampling protocol.

Reginal Harrell (RH):
- Could one consider the feasibility of capturing young of the year and marking them, perhaps with coded wire tags, and then do a mark-recapture study to assess the degree to which young of the year are migrating among rivers? Combine this work with genetic analyses to enable you to follow families. Response by Mike Robinson: Yes, it would be feasible.

Rod Bradford (RB):
- Definition of "extirpated" on page 16 may require qualification. Response: Are we generally accepting that non-Miramichi rivers do not have any remnant parents around? When we say extirpated, we mean gone.

Roger Rulifson (RR):

Regarding annual variability, would you have to back each year to re-assess stock status and genetic variability, underscores importance of sampling properly over space and time. Another issue is whether the genetic markers are inherently stable. Response by SC: heritability of RFLP DNA – there is disagreement as to whether heritable variation exists or not, and there is a big difference between heritability and temporal stability of RFLP mtDNA data.

OVERVIEW OF STRIPED BASS AQUACULTURE BREEDING PROGRAMS AND REVIEW OF STUDIES CONDUCTED ON THE INTERACTION BETWEEN AQUACULTURE ESCAPEES AND WILD STRIPED BASS IN THE UNITED STATES.

Working Paper(s): WP98-105 – Paper 5

Author: Harrell, Reginal

Referees: Hammell, Larry and Hutchings Jeff

Rapporteur: Bradford, Rod

Summary/Abstract:

[unavailable]

Issues/Concerns: (Including response)

1 Time constraints prevented the author from tabling a draft document for review prior to the workshop. The rapporteur's report therefore largely reflects the verbal comments of the referees and attendees to the presentation. There was general agreement among the participants on the following major points.

2. Stocking programs with hatchery-produced fish have, on occasion, been incompatible with the long-term genetic health of natural populations through decreasing genetic variability, causing introgressive hybridization, and/or displacing native fish.

3. Loss of phenotypic variability in broodstock can occur as a consequence of broodstock management practices. Generally, genetic drift can be attributed to husbandry practices (e.g., broodstock selection, inbreeding, directed selection, unequal progeny distribution, domestication) and/or to biological processes occurring within the captive environment (e.g., convergent selection, dominant males, genetic drift, outbreeding depression).

4. Fish breeders need to maintain a good hatchery environment. Criteria for broodstock acquisition, selection, husbandry, and breeding will differ depending on the purpose of the artificial rearing program (aquaculture, fisheries enhancement, stock restoration).

Consensus:

- **Research Recommendation**

1. Genetic discreteness of the wild Canadian striped bass stocks should be confirmed

through investigations on nuclear DNA.

- **Management Consideration**

1. Intentional releases of cultured striped bass into the wild for the purpose of recreational fishery enhancement should not proceed where 'genetically pure' strains of wild striped bass exist; i.e., no prior stocking history or risk of interaction.
2. Activities related to the commercial aquaculture of striped bass where 'genetically pure' strains of wild striped bass exist should be conducted in a fashion that precludes risk of introgression between wild and cultured striped bass.

STRIPED BASS STOCKING PROGRAMS IN THE UNITED STATES: ECOLOGICAL AND RESOURCE MANAGEMENT ISSUES

Working Paper(s): Paper 6 (WP98-106) - Paper 6

Author: Rulifson, Roger; Laney, Wilson, R.

Referees: Chaput, Gérald; and Courtenay, Simon

Rapporteur: Robichaud-LeBlanc, Kim

Summary/Abstract:

The striped bass (*Morone saxatilis*) has been an important commercial, recreational and socio-economic resource along the U.S. eastern seaboard since earliest colonial times. The first colony resource laws, written in 1639, addressed conserving the striped bass resource. Concerns about population declines in the late 1800s resulted in the first attempts to culture striped bass in a manner similar to that for American shad, *Alosa sapidissima*. The Roanoke River population in North Carolina served as the original culture stock beginning in 1884, and for many years eggs, fry and fingerlings of Roanoke origin were stocked in watersheds throughout the eastern seaboard and along the Gulf of Mexico. These fish were used for stock enhancement and for stock restoration programs. In the 1980s, concern about stock collapse throughout the range, and preserving any remaining genetic integrity of striped bass populations, led the Atlantic States Marine Fisheries Commission (ASMFC) to endorse a large culture and stocking program of Age 0 fish. Brood fish from "natal rivers" were used, with progeny returned to the watershed of the brood parentage. However, the 100+-year-old practice of cross-stocking young and adults, and the continued practice of cross-stocking at the state level, have resulted in the introgression of non-endemic genetic strains to many striped bass populations along the east and Gulf coasts. Effects of this long-standing practice remain undocumented and unquantified. This manuscript documents the use of these strains for stock rebuilding and maintenance programs, and addresses issues concerning survival of stocked fish, implications of ecological incompatibility of cross-stocked fish, and management problems associated with these issues.

Issues/Concerns: (Including response)

Referee 1 -- Gérald Chaput: Specific concerns/comments follow:

1. I would add "Present Stock Status" section in INTRODUCTION with other sections (historical perspective, importance, reasons for decline, ways to reverse the trend).

2. Terminologies need to be clarified:
   - What is a "stock" , " race", "species", "strain", "population"?
   - What is basis for stock analysis (genetic, tagging)?

RESPONSE: a "stock" on a management level and genetic level are not the same.

3. Need to attribute cause of the decline in the US to antropogenic changes and fisheries.

4. What evidence exists of the homing and spawning site fidelity of striped bass in NE USA?
RESPONSE: wild striped bass, especially males do not home. There is system but not river fidelity, There is lots of wandering. May be an issue worth considering at northern end of range.

5. What is reference for genetic heritability of egg size?

6. What is the conservation threshold (population size) that triggers major fisheries closures?
RESPONSE: It's based on a running average.

7. On page 8, section "Why enhance":
"The biggest impact is when stock abundance is low we stock enhance" (potential for significant impacts on genetics are greater when the relative contribution from enhancement programs is high).

R. Harrell: hatcheries supplement natural stock to keep a certain running level.

8. Closing comments:
- Overview of a large issue in US
- Document is large on history (which is good), but short on present situation
- Propose alternatives to genetics for resource management
- Main message from the paper is that in spite of all that we've thrown at striped bass (habitat degradation, overfishing, cross-stocking reducing fitness), this species appears resilient/persistent when left alone and probably does not require human intervention in the way of enhancement. This being said I don't think we "not do anything".
- You need a map.

Referee 2 -- Simon Courtenay: Specific concerns/comments follow:

1. Conclusions and recommendations all seem to make sense.

2. The fact that stocking has been successful and you still see genetic differences raises a few questions:
   - How good are our measures that things are different?

- How many populations do we have?
- The number of strains to wash out genetic signature is small for salmon, then why are we still seeing differences in bass?

RESPONSE: What is the biological significance. We should be looking at ecological compatibility.

3. As you see the natural population recover you see hatchery fish signature disappear, which suggest intense selection.

4. Recommendation about natural recolonisation: Rod Bradford's tagging study shows that striped bass migrate great distances. If conditions were right why don't striped bass naturally recolonise the St. Lawrence?

5. It's a trade off between cost of stocking and management of wild stocks.

6. Holding and wandering issue: "fish of spawning size on spawning grounds at spawning time." I don't think that is a good indication of spawning. I think nothing can replace looking for eggs and larvae.

7. Some jargon needs to be defined: fall line, benchmark levels.

Consensus:

- **Research Recommendation**

1. Research marking techniques which could be used to track wild fish.

- **Management Consideration**

1. Population should be managed conservatively with respect to maintaining genetic diversity, sustainability and ecological functions
2. Our (conservative) view is to impose sufficient regulatory measures to ensure adequate protection.
3. If stock enhancement is selected, adopt measures recommended by Upton (1996) regarding
    - Disease considerations
    - Tagging programs
    - Restoration criteria
    - Genetic and hybrid concerns
    - Stocking strategies
    - Provincial coordination
    - Evaluation

- **Others**

1. Rod Bradford: In terms of known extirpation. Any attributed to overfishing opposed to habitat degradation?

   Roger Rulifson: No document summarizes this information.

   Reginal Harrell: Only known one is the Delaware.

2. Rod Bradford: Could the effluent from a pulp mill contribute to spawning site fidelity in Miramichi? Has anything been looked at in the US?

   Roger Rulifson: In US, lots of problems began when they put up mills for grinding grain. It's worthy of exploration.

3. Tagging versus egg collection issue to identify spawning :

   Reginal Harrell: Wire tag fish showed up in systems where they were not released. Just because you stick a tag in a fish doesn't mean it's a wild fish. What we have been discussing about genetics is theory based on what we know about other species.

   Gérald Chaput: Disagree: tagging over several years shows a lot about spawning site fidelity. We have gaspereau traps in many of the estuaries in the southern Gulf and we don't get recaptures there.

   Rod Bradford and Gérald Chaput: Disagree that sampling for eggs and larvae is only way to determine presence of spawning population. It takes 5 years from time you sample eggs to returning spawning female (life cycle closure).

   John Ritter: What information exist for survival rates between life stages?

   Reginal Harrell: Sonic tagging for tracking is expensive but can give good information on homing.

4. Gérald Chaput: There is a debate over 1 or several populations in southern Gulf. Chesapeake Bay and Gulf of St. Lawrence are similar in the sense that they both may be 1 unit and managed as 1 stock.

   Roger Rulifson: Suggestion: Miramichi is center of abundance for southern Gulf but adjacent watersheds could be used in certain years.

GENETIC INTERACTION BETWEEN ARTIFICIALLY-REARED AND WILD CANADIAN STRIPED BASS *(MORONE SAXATILIS)*: RISK AND UNCERTAINTIES

Working Paper(s): WP98-107 - Paper 7

Author: Bradford, Rod; and Hutchings, Jeffery

Referees: Courtenay, Simon; and Rulifson, Roger

Rapporteur: Cairns, David

Summary/Abstract:

Survivorship at northern latitudes of young-of-the-year striped bass through their first winter is a function of pre-winter body size. Fish less than 10 cm fork length are culled naturally from the population, probably through processes associated with osmotic stress at low temperatures and poor starvation endurance during the 5 month winter period of fast. Consequently, striped bass exhibit a pronounced counter-latitudinal gradient in intrinsic somatic growth rate among reproductively discrete populations. Eastern Canadian populations possess the highest growth rates known for this species, an attribute that has fostered interest in the culture of 'northern' striped bass for commercial purposes (aquaculture). This manuscript examines potential risks to the viability of wild populations posed by interbreeding with escaped farmed striped bass, particularly those reared under artificial conditions that would effectively eliminate the natural culling of smaller bodied fish. Results are also discussed in the context of striped bass stocking programs, either to enhance production within existing stocks or for the restoration of striped bass to river estuaries that at one time supported spawning.

Issues/Concerns: (Including response)

1. R. Harrell: There may be questions regarding the desirability of stocking. But if you're too cautious you may throw the baby out with the bathwater i.e. you may forgo some important opportunities by holding back from any stocking.

2. R. Harrell: (referring to J. Hutchings). The wording reflects the viewpoint of an evolutionary biologist, or wild resource manager. It would be better to use neutral wording.

3. R. Harrell: Table 3 - need error terms.

4. R. Rulifson: Title doesn't reflect contents. He had difficulty following through paper because of the title, and because of a gulf between the paper's two sections. Need an

introduction that gives guidance to readers so they will know where paper is going.

5. R. Rulifson: There is selection for high growth prior to cold winters. But what happens when winters are mild? In such cases there could be other factors, including aggressive behavior. The paper should deal with these factors, including possible differentials in aggressive behaviour between wild and hatchery fish. Changes could be tracked with binary code wire tags, or genetic markers.

6. R. Rulifson: the paper deals with rapid growth in the first year. But Harrell's work shows the growth advantage of northern stocks doesn't necessarily hold up over a longer time frame. This should be acknowledged.

7. D. Cairns: A major premise of the paper is that genetics has a significant influence on the sizes of fish at the end of the first growth year, i.e. that fish that are smaller than the survival cut-off (in cold years) are generally smaller than others in the cohort, to a significant extent, because of genetic effects. He argued that in the Miramichi population there is likely to be very strong pressure that has continued for thousands of years for rapid growth in the first year. The argument is that, due to such pressure, there would be little variability in intrinsic growth rate, and that all fish are genetically adapted to growing to the limits set by physiology. If this is true, then genetic variability would have an insignificant role in producing the fish that are small at the end of the season.

8. R. Bradford: The issue is whether or not these inferior growth traits would persist during periods when environmental conditions favour high survivorship of first winter (i.e. early spawning, warm summer, good winter survival). Thus escapees with inferior growth traits (escapees) could contribute to spawning with apparently benign effects until conditions conducive to poor survival occur.

9. R. Peterson: The models are density independent. Things might be different at high population numbers.

10. R. Peterson: Fishing directed at large fish may have effects on genetics and populations due to relation between female size and egg size etc.

11. The implications of spawning waves was questionned. Males stay on spawning grounds but females come and leave. This may have implications for genetics and result in half siblings etc. R. Harrell: this can be tracked using mtDNA.

Consensus:

- **Management Consideration**

1. A precautionary approach to further developments in the artificial-rearing of striped bass in Canadian waters either for aquaculture, enhancement, or restocking is advised.

2. The development of a precautionary management strategy to address both intentional and unintentional releases to the wild of artificially reared striped bass should include an evaluation of risks associated with the release of fish at each life history stage.

3. Releases to the wild of any striped bass that have never been exposed to the natural culling processes in effect during the first winter should be prohibited until the role of growth in winter survivorship is fully understood. This policy would include placement of 'artificially wintered' striped bass in grow-out facilities where there is a risk of escapement.

4. In the short term, introductions and transfers of striped bass between biogeographic regions harbouring extant wild populations of striped bass is to be prohibited.

A REVIEW OF POTENTIAL IMPACTS ON WILD STRIPED BASS STOCKS FROM FISH DISEASES ATTRIBUTED TO ARTIFICIALLY REARED STRIPED BASS OPERATIONS

Working Paper(s): WP98-108 - Paper 8

Author:

Referees:

Rapporteur:

[CANCELLED]

PARASITES AND DISEASES OF CULTURED AND WILD STRIPED BASS: REVIEW OF CURRENT KNOWLEDGE

Working Paper(s): WP98-109 - Paper 9

Author: Hogans, William

Referees:

Rapporteur: McGladdery, Sharon and Klassen, Greg

[CANCELLED]

STRIPED BASS IN THE MARITIME PROVINCES: THE REGULATORY ENVIRONMENT

Working Paper(s): Paper 10 (WP98-110) - Paper 10

Author: Stevens, Greg; Dunn, David; and Jenkins, James B.

Referees: Ritter, John

Rapporteur: Jessop, Brian

Summary/Abstract:
Striped bass fisheries, introductions, transfers, and enhancement activities in the Maritime Provinces are managed by the Department of Fisheries and Oceans under the Fisheries Act and its associated regulations, including the Fisheries (General) Regulations, the Maritime Provinces Fisheries Regulations, and the Aboriginal Communal Fishing Licenses Regulations. Commercial striped bass fishing is not permitted in the Maritimes and striped bass incidentally caught in other fisheries cannot be retained. Angling is permitted in inland waters according to sport fishing seasons. In the Scotia-Fundy sector, retention of one fish is permitted. In the Gulf sector, all fish caught must be released. Applications for introductions and transfers of striped bass are reviewed by committees based in each Maritime province. Risk of disease transmission is scrutinized carefully during application reviews, and conditions that minimize this risk may be imposed on licenses to introduce or transfer. A five year striped bass management plan, implemented in 1995, prohibits removals of wild fish for culture and enhancement purposes, except for cases where small numbers are needed for applied research.

Issues/Concerns: (Including response)

1. What legislation, if any, protects striped bass habitat, i.e., eel grass beds? Response: Various pieces of federal and provincial legislation, including the habitat sections of the Fisheries Act.

2. Add a section on provincial responsibilities and regulations for recreational fishing and aquaculture, by province. Response: Sections covering these topics will be added.

3. Is there a formal Advisory Committee in the Gulf sector; if not, how adequate is the present consultation process? Response: In the Gulf sector, the public is consulted via the Science Workshop, which seems adequate, but a formal Advisory Committee is an option to consider.

4. Are there any recommendations for regulatory changes at this time? Response: No recommendations for regulatory change are being made at this time.

5. Are there requirements for licenses where striped bass are transferred out of a province, to the U.S. for example? Response: The Fishery (General) Regulations cover the transfer of fish. Technically, the requirement for a license to transfer fish could be applied to the shipper but this is not normal practice. Other legislation, such as for the Canada Food Agency, may apply if certificates of origin are required.

6. Is genetics considered in the criteria used for approval of licenses for striped bass transfer? Response: Yes; at the Introduction and Transfer Committee level and via the regular routing of licenses through the internal approval process.

7. Do local transfers of striped bass collected under previous permits under the Introductions and Transfer regulations require new permits for transfers between facilities/sites? Response: Transfers not explicitly covered under a given permit generally require a new permit.

Consensus:

- **Management Consideration**

1. Establish Advisory Committees in the Gulf sector, by province or geographic area as necessary.

Participant	Affiliation/Address	Telephone	Fax	E-Mail
Angus, Randy	Cardigan Fish Hatchery / Cardigan, PEI	902-583-2952	902-583-3223	Rangus@upei.ca
Bagnall, Andrew	NS DFA / Halifax, NS			
Bradford, Rod	DFO / Dartmouth, NS	902-426-4555	902-426-6814	BradfordR@mar.dfo-mpo.gc.ca
Cairns, David	DFO / Charlottetown, PEI	902-566-7825	902-566-7948	CairnsD@mar.dfo-mpo.gc.ca
Chaput, Gérald	DFO / Moncton, NB	506-851-2022	506-851-2147	ChaputG@mar.dfo-mpo.gc.ca
Courtenay, Simon	DFO / Moncton, NB	506-851-6709	506-851-2079	CourtenayS@mar.dfo-mpo.gc.ca
Douglas, Scott	Acadia University / Wolfville, NS – DFO / Moncton, NB	902-542-2201 506-851-3218	902-585-1072 506-851-2147	DouglasS@mar.dfo-mpo.gc.ca
Gallant, Richard	Fisheries and Tourism / Charlottetown, PEI	902-368-5524	902-368-5542	Rkgallant@gov.pe.ca
Groman, Dave	Atlantic Veterinary College, UPEI / Charlottetown, PEI	902-566-0830	902-566-0723	Groman@upei.ca
Hambrook, Mark	Miramichi Fish Hatchery / Miramichi, NB	506-622-1781	506-622-6111	Hambrook@nbnet.nb.ca
Hamilton, Roland F.	Hamilton's Eel fishery Ltd.			
Hammell, Larry	Atlantic Veterinary College, UPEI / Charlottetown, PEI	902-566-0879	902-566-0823	Lhammell@upei.ca
Harrell, Reggie	University of Maryland / Maryland, USA	410-221-8466	410-221-8456	Harrell@hpl.umces.edu
Hayward, John	DFO / Moncton, NB	506-778-2837		mirfish@nbnet.nb.ca
Hutchings, Jeff	Dalhousie University / Halifax, NS	902-494-2687		Jeff.Hutchings@dal.ca
Jessop, Brian	DFO / Dartmouth, NS	902-426-2158	902-426-6814	JessopB@mar.dfo-mpo.gc.ca
Klassen, Greg	Tau Biodiversity / Memeramcook, NB	506-758-0990	506-758-8094	Grog@nbnet.nb.ca
LeBlanc, Léophane	Parc National Kouchibouguac / Kouchibouguac, NB	506-876-1229	506-876-4283	Leophane_leblanc@pch.gc.ca
Lutzac, Tim	DFO / Moncton, NB	506-851-2072	506-851-2147	LutzacT@mar.dfo-mpo.gc.ca
Mac Mark, Neil	Fisheries and Tourism / Charlottetown, PEI			
McGrath, Darren				
Meerburg, Dave	DFO / Ottawa, ON	613-990-0286	613-954-0807	Meerburd@dfo-

Participant	Affiliation/Address	Telephone	Fax	E-Mail
				mpo.gc.ca
Peterson, Richard	St. Andrews Biological Station / St. Andrews, NB	506-529-5978	506-529-3236	PetersonR@mar.dfo-mpo.gc.ca
Ritter, John	DFO / Dartmouth, NS	902-426-3136	902-426-6814	RitterJ@mar.dfo.mpo.gc.ca
Robichaud-LeBlanc, Kimberly	DFO / Dartmouth, NS	902-426-5836	902-426-6814	RobichaudK@mar.dfo-mpo.gc.ca
Robinson, Mike	UNB / Fredericton, NB – DFO / Moncton, NB	506-453-4583		"y4q4@unb.ca"
Rulifson, Roger	East Carolina University / North Carolina, USA	252-328-1757	252-328-4265	RulifsonR@mail.edu.ecu
Stevens, Greg	DFO / Halifax, NS	902-426-5433	902-426-9683	StevensG@mar.dfo-mpo.gc.ca
Wheaton, Fred	NB Wildlife Federation / Moncton, NB	506-382-3507	506-857-2213	

Instruction Letter to Authors

Fisheries and Oceans / Pêches et Océans

Science Branch
Maritimes Region
1505 Barrington Street
Halifax, N.S.
B3J 3K5

October 23, 1998

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»,
«Address2»
«City», «State»,«PostalCode»

RAP Workshop: ***Interaction Between Wild and Artificially-Reared Striped Bass in the Maritime Provinces***

Dear «Title» «LastName»:

This letter is to confirm arrangements for the Workshop. The preparations are going well and we expect a productive and well-attended meeting.

The format for the review centers around one hour being assigned to each of the formal papers. That hour will be divided into fifteen minute segments for presentation of the paper, comments from two assigned referees, and comments from the scientific review panel. Time will also be made available for comments and questions from the attendees at large.

All invited papers will be upgraded to Research Documents following the meeting. Attached you will find the details on the required format for your paper(s). I have also enclosed a copy of a Research Document cover page to assist you in setting up your manuscript. Please take note that publication as a Research Document does not preclude publication elsewhere. As applicable, we request that you incorporate both future research and management recommendations in your paper.

We intend to provide each participant with a folder containing the final Terms of Reference for the Workshop, which will include the titles and a listing of the main points to be covered in each paper. We also will be including the abstracts in this folder. To assemble this package we require your final title(s), the main points to be covered in your paper(s) (preferably in bullet form), and your abstract(s) by no **later than 30 October, 1998**. We would appreciate receiving an electronic version of these items in Word 6.0 format, if feasible. Please send these to RobichaudK@mar.dfo-mpo.gc.ca.

Please be advise that the Workshop is scheduled to be held in the Miramichi Room at GFC, Moncton, N.B. Regarding accommodations, a blanket booking has been made at the Best Western Crystal Palace Hotel for December 8 to 10 (Tuesday through Thursday). It is essential that you confirm your reservation by **November 20, 1998**. The Crystal Palace reservation numbers are (506) 858-8584 or 1-800-561-7108.

I look forward to receiving your manuscript in due course and to seeing you at what promises to be a productive workshop.

Sincerely yours,

John A. Ritter, Manager
Diadromous Fish Division

Attachment

Canada

Department of Fisheries and Oceans
Regional Assessment Process Workshop on
"Interactions Between Wild and Artificially-Reared Striped Bass in the Maritime Provinces"

Notes to Authors

General:

1. Research documents should be type-written single spaced and on one side of good quality white bond paper size 8½ x 11 inches (220 x 280 mm).

2. Leave all margins 1 inch (25 mm) to 1½ inches (38 mm).

3. A cover page is required and is to be set up in accordance with the attached sample.

4. Number pages consecutively with Arabic numerals this includes page numbers on the tables and figures. The cover page will be considered the first page and will not be numbered.

5. Wherever practical, the text should be sub-headed into Abstract, Résumé, Introduction, Materials and Methods, Results, Discussion, Management Considerations, Research Recommendations, Acknowledgements, References, Tables, Figures and Appendices. If the author wishes to include a summary of the conclusions it should follow the "Discussion" section.

6. All measurements, linear, weight, and time should be given in numerals (not words) in the metric system. The Celsius scale should be used as a standard. Notations used are left to individual preference. However, once a particular notation is adopted it is to be used consistently throughout the paper.

7. An electronic version of all abstracts are to be submitted in Word 6.0 format to RobichaudK@mar.dfo-mpo.gc.ca by October 30, 1998

8. All documents are to be submitted in hard copy and on disk in Word 6.0 format, if feasible, to the address at the head of this letter or via e-mail **to RobichaudK@mar.dfo-mpo.gc.ca by October 30, 1998.**

Abstract/Résumé:

1. An abstract or résumé is to be included in the document. This section should not exceed 3% of the length of the text or 250 words whichever is smaller.

2. The translation of the abstract or résumé will be coordinated by the Canadian Stock Assessment Secretariat in Ottawa, however, an author may submit this section in both French and English.

Bibliography:

1. References to literature in the text should be by the author date system, for example:

   It was reported that (Collins 1960) the ...
   In examining the situation, Rossini (1959) felt ...

Where more than one paper by the same author(s) have appeared in one year, reference should be given as follows:

   Osborne and Mendel (1914a); Osborne and Mendel (1914b)
   or Osborne and Mendel (1914a and b)

2. While the names of two authors may be used in a citation as shown above, three or more authors should be cited as (Collins et al. 1960). Reference to papers submitted but not yet published should be indicated as being "in press" or "submitted for publication" depending on whether or not the paper has been accepted for publication.

Reference to material not submitted for publication should be written in the text...e.g. George (pers. comm.) or George (unpublished manuscript).

3. All references cited by the author-name system in the text should be listed in the bibliography alphabetically by the surname of the first author, year of publication follows the authorship. Then give the full title of the paper. This should be followed by the abbreviated name of the periodical with the volume and pages in Arabic numbers. Abbreviations of periodicals should, if possible, follow the "World List of Aquatic Sciences and Fisheries Serial Titles", published periodically by FAO. References to monographs should, in addition to the authors, year and title, contain the name of the publisher, place and number of pages in the volume.

4. References cited in the text must be given in the bibliography and conversely, items listed in the Bibliography must be cited in the text.

5. CSAS working papers and subcommittee reports have no status as documents and cannot be cited.

6. CSAS, DFO, NAFO, ICNAF, ICCAT and ICES research documents are unpublished material and should be referenced as manuscripts, e.g. (Collins MS 1960), in both text and bibliography.

Tables:

1. Tables can be set out on separate sheets following the bibliography or they can be incorporated into the text.

2. Tables should be numbered consecutively in Arabic numbers.

3. Tables must be referred to in the text.

4. Each table should provide a description heading which together with the column heading must make it intelligible without reference to the text. The caption is to be typed on the same page as the table to which it applies.

5. If two or more small tables can be placed on one page in an aesthetically pleasing manner, this should be done.

6. The calculations made in the tables should be checked for accuracy at the office of the author prior to the submission of the document.

Figures:

1. Figures can be placed following the tables and should commence on a separate sheet or they can be incorporated into the text.

2. All illustrations, whether black-and-white drawings, tone drawings, maps, graphs, or photographs are considered figures. If photographs are included, a black-and-white print must be submitted. All material will be reproduced by a photocopy unit, therefore the submission must be of sufficient line density that touch-up is not required.

3. Figures should be on 8½ x 11 inches (220 x 280 mm) white paper. The margins to be observed are 1 to 1½ inches (25 to 38 mm). Lettering should be of sufficient density and size to photocopy clearly.

4. Figures are to be numbered consecutively in Arabic numerals.

5. Each figure must be referred to in the text.

6. Each figure should provide a description heading and a legend and should be intelligible without reference to the text. The caption is to be typed on the same page directly underneath the figure to which it applies.

Submission of Research Documents:

1. The original of the research document is to be submitted to the Canadian Stock Assessment Secretariat at the address noted below along with an electronic version of the abstract to Hamelj@dfo-mpo.gc.ca:

   Canadian Stock Assessment Secretariat
   Department of Fisheries and Oceans
   200 rue Kent Street, Stn. 1256

Ottawa, Ontario
Canada K1A 0E6

2. Research documents must be accompanied by a memorandum, letter or form signed by the line manager of the author approving the document for release. This applies to documents submitted by personnel from Fisheries and Oceans and other agencies. Please note authority for approval is restricted to line managers at the Division Chief level and equivalent or above.

3. Manuscripts requiring substantial revision to bring them into conformity with the above format will be returned to the author for correction.

Letter to Panel Members

Fisheries and Oceans / Pêches et Océans

Science Branch
Maritimes Region
P.O. Box 550
Halifax, NS
B3J 2S7

Nov. 26, 1998

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»,
«Address2»
«City», «State»,«PostalCode»

Dear «Title» «LastName»:

This letter is to invite you to serve on our scientific review panel for a Special Workshop on the "Interaction Between Wild and Artificially-Reared Striped Bass in the Maritime Provinces". The Workshop is being carried out as part of our Regional Assessment Process (RAP). Our task is to carry out a scientific review of the subject with the objectives being to provide management advice and recommendations for future research. As a member of the review panel you would be expected to attend all sessions, to the extent possible.

The Workshop will be held from **December 9, 1998 to December 11, 1998**, in the Miramichi Room of the Gulf Fisheries Center, 343 Archibald Street, Moncton, N. B. It will commence at 8:00 a.m. on Wednesday, the 9th.

The format for the review centers around one and a half hours being assigned to each of the nine formal papers. That time will be divided into fifteen minute segments for presentation of the paper, comments from the two assigned referees, comments from the scientific review panel, and comments and questions from the attendees at large.

Enclosed is a program for the Workshop which includes a brief outline of each of the formal papers. Also for your information we have included the proposed agenda with schedule for the presentations and a list of invited review panel members. We will also be sending you copies of each of the papers being presented at the workshop as we receive them.

We will be please to reimburse you for all travel expenses. Regarding accommodations, a blanket booking has been made at the Best Western Crystal Palace Hotel, for December 8, 1998 to December 10, 1998 (Tuesday through Thursday). If you chose to take advantage of the blanket booking you would get the workshop preferred rate ($69.95 per night plus tax for a single) but you would be responsible for the room charges. To take advantage of the blanket booking, it is essential that you **confirm your reservation by November 23, 1998**. The Crystal Palace reservation numbers are (506) 858-8584 or 1-800-561-7108.

We hope you agree to participate in this important scientific review exercise. As space is limited we **require an RSVP** which can be sent to Kimberly Robichaud-LeBlanc at the above address, or she can be contacted directly by telephone (902-426-5836), fax (902-426-6814), or e-mail (RobichaudK@mar.dfo-mpo.gc.ca).

Sincerely,

John A. Ritter, Manager
Diadromous Fish Division

Attachment

Canada

Letter to Observers

Fisheries and Oceans / Pêches et Océans

Science Branch
Maritimes Region
P.O. Box 550
Halifax, NS
B3J 2S7

Nov. 26, 1998

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»,
«Address2»
«City», «State»,«PostalCode»

Dear «Title» «LastName»:

This letter gives notice of a Special Workshop on the "Interaction Between Wild and Artificially-Reared Striped Bass in the Maritime Provinces". This workshop is being carried out as part of our Regional Assessment Process (RAP). Our task is to carry out a scientific review of the subject with the objectives being to provide advice for management and recommendations for research.

The Workshop will be held from December 9, 1998 to December 11, 1998, in the Miramichi Room of the Gulf Fisheries Center, 343 Archibald Street, Moncton, N. B. It will commence at 8:00 a.m. on Wednesday, the 9th.

Space is limited, however you and/or representatives of your organization are welcome to come and participate in those sessions in which you have interest. The format for the review centers around one and a half hours being assigned to each of the formal papers. That time will be divided into fifteen minute segments for presentation of the paper, comments from the two assigned referees, comments from the scientific review panel, and comments and questions from the attendees at large. A few minutes of the final fifteen minutes will be used for summing-up as well. This format will be clearly laid-out at the start of the workshop and will be adhered to by necessity in order to complete the agenda.

Enclosed is the program for the Workshop. It includes the proposed agenda and schedule for presentation of the various papers. Please note however that the schedule is subject to last

minute changes due to the possibility of discussions of some papers running-on longer than the assigned one hour. To confirm timings of particular presentations, please contact Marie Daigle at (506) 851-6253.

We welcome your attendance and participation in this important workshop. We are unable however, to assist in any way with your travel expenses.

Sincerely,

John A. Ritter, Manager
Diadromous Fish Division

Attachment

Canada

Appendix 2 – Observers

Observers

Meeting open to everyone, including media. Special invitations sent to the following:

Names	Association
Mr. Harry **Collins** President	Miramichi River Environmental Assessment Committee (MREAC) P.O. Box 8, 410 Water Street Miramichi, NB E1N 3A5 (tel) 506-778-8591 (fax) 506-773-9755 MREAC@nbnet.nb.ca
Dr. James **Dunstan** Assistant Professor	Nova Scotia Agriculture College Department of Animal Science P.O. Box 550 Truro, NS B2N 5E3 (tel) 902-893-8037 (fax) J.Duston@nsac.ns.ca
Mr. Richard **Gallant** Aquaculture Biologist	Department of Fisheries and Tourism Fisheries and Aquaculture Division 11 Kent Street, Box 2000 Charlottetown, PEI C1A 7N8 (tel) 902-368-5524 (fax) 902-368-5542 rkgallant@gov.pe.ca
Mr. Trevor **Goff** Manager	Mactaquac Fish Hatchery 114 Fish Hatchery Lane French Village Yorkes, NB (tel) 506-363-3126 (fax) 506-363-4566 GoffT@mar.dfo-mpo.gc.ca

Names	Association
Mr. Daryl **Guignion**	PEI Wildlife Federation c/o Biology Department University of PEI Charlottetown, PEI C1A 4P3 (tel) 902-566-0676 (fax) 902-566-0301 dguignion@upei.ca
Mr. John **Hayward**	242 Big Ferry Road Miramichi, NB E1V 6Y3 (tel) (506) 778-2837 mirfish@nbnet.nb.ca
Mr. Murray **Hill** Director	NS DoF, Inland Waters Division P.O. Box 700 Pictou, NS B0K 1H0 (tel) 902-485-7021 (fax) 902-485-4014 hillm@gov.ns.ca
Mr. Wayne **Hooper**	Atlantic Veterinary College University of Prince Edward Island 550 University Avenue Charlottetown, PEI C1A 4P3 (tel) 902-969-7152 (fax) 902-566-0823
Ms. Betty Ann **Levallee** President	Aboriginal Peoples Council of New Brunswick 320 St. Mary's Street Fredericton, NB E3A 2S4 (tel) 506-458-8422 (fax) 506-451-6130

Mr. Terry **MacIntyre** President	Nova Scotia Salmon Association 102 Pomquet Road RR#7, Antigonish, NS B2G 2L4 (tel) 902-386-2552 (fax) 902-386-2334 nssalmon@auracom.com
Ms. Marli **MacNeil** Executive Director	Aquaculture Association of Nova Scotia (AANS) P.O. Box 802, Stn M. Halifax, NS B3J 2V2 (tel) 902-422-6234 (fax) 902-422-6248 aquans@fox.nstn.ca
Mr. Tim **Martin**	Native Council of Nova Scotia P.O. Box 1320 Truro, NS B2N 5N2 (tel) 902-895-1523 (fax) 902-895-0024
Mr. Christopher **Milley** Executive Director	Mi'Kmaq Fish and Wildlife Commission Afton First Nation Afton, NS B0H 1A0 (tel) 902-386-2718 (fax) 902-386-2676
Mr. Leo **Muise** Director	NS DoF, Aquaculture Division P.O. Box 2223 Halifax, NS B3J 3C4 (tel) 902-424-3664 (fax) 902-424-1766 muiselj@gov.ns.ca

Mr. Paul **Neima** Director	Aquaculture Alliance of PEI 68 Watts Avenue Charlottetown, PEI C1E 2B7 (tel) 902-368-2757 peiaqua@pei.sympatico.ca
Mr. Robert N. **O'Boyle** RAP Co-ordinator	Department Fisheries and Oceans Maritime Region, Science Branch Bedford Institute of Oceanography P.O. Box 1006 (1Challenger Dr.) Dartmouth, NS B2Y 4A2 (tel) 902-426-3526 OBoyleR@mar.dfo-mpo.gc.ca
Mr. Darrell **Paul** Executive Director	Union of NB Indians 385 Wilsey Road, Compartment 44 Fredericton, NB E3B 5N6 (tel) 506-458-9444 (fax) 506-458-2850
Mr. David **Scarratt** Editor	Recirc Today (tel) 902-423-6955 (fax) 902-423-2720 scarratt@ns.sympatico.ca
Mr. Eric **Tremblay** Park Ecologist	Department of Canadian Heritage Kouchibouguac National Park, Kouchibouguac, Kent Co., NB E0A 2A0 (tel) 506-876-2443 (fax) 506-876-4802 eric_tremblay@pch.gc.ca

Letter to Referees

Fisheries and Oceans / Pêches et Océans

Science Branch
Maritimes Region
P.O. Box 550
Halifax, NS
B3J 2S7

Nov. 4, 1998

«Title» «FirstName» «LastName»
«JobTitle»
«Company»
«Address1»,
«Address2»
«City», «State»,«PostalCode»

Dear «Title» «LastName»:

This letter is to confirm my invitation to you to serve as a referee at a Special Workshop on the "Interaction Between Wild and Artificially-Reared Striped Bass in the Maritime Provinces". This workshop is being carried out as part of our Regional Assessment Process (RAP). Our task is to carry out a scientific review of the subject with the objectives being to provide management advice and recommendations for future research.

The Workshop will be held December 9, 1998 to December 11, 1998, in the Miramichi Room at GFC, 343 Archibald Street, Moncton, N. B. It will commence at 8:00 a.m. on Wednesday, the 9th.

The paper that we are asking you to review is entitled "xx" by xx (paper x of outline). For your information and guidance, we are pleased to provide a copy of the most recent draft "Terms of Reference" for the Workshop. We will be forwarding the paper to you in the near future along with an agenda, a list of the invited participants, and some suggested "Considerations for Referees".

We are pleased to reinburse you for all travel expenses. Regarding accommodations, a blanket booking has been made at the Best Western Crystal Palace Hotel, for December 8, 1998 to December 10, 1998 (Tuesday through Thursday). It is essential that you **confirm your**

reservation by November 20, 1998. The Crystal Palace reservation numbers are (506) 858-8584 or 1-800-561-7108.

Thank you for agreeing to participate in this important scientific review exercise.

Sincerely,

John A. Ritter, Manager
Diadromous Fish Division

Attachment

Department of Fisheries and Oceans
Regional Assessment Process Workshop on
"Interactions Between Wild and Artificially-Reared Striped Bass in the Maritime Provinces"

Notes of Guidance for Referees

Please review the document and provide comments (at the peer review) on the methodology, interpretations and recommendations. You will be expected to provide an oral review of the paper assigned to you along with written comments and/or edits to the senior author. Also, we are hoping that you will agree to provide a final review of the same manuscript prior to its publication.

Referees may find it helpful, when reading the manuscript, to have in mind the key questions on which your advice is being sought, namely:

1. Is the purpose of the Working Paper clearly stated?

2. Does the paper make a worthwhile contribution to knowledge; e.g., byway of new data, techniques or ideas? If so, is it properly placed in the context of existing knowledge, giving due recognition to published work?

3. Is the evidence and argument presented clearly and concisely, or is the paper unduly long for the message it is conveying? If the latter, how might it be shortened without loss?

4. If appropriate, is the methodology (including sampling, experimental design and theory) sound?

5. Are the text, tables and figures mutually consistent, sufficient (but not excessive) and clear?

6. Are there specialised parts (e.g. mathematics/statistics) on which you would prefer someone else to comment? If so, could you suggest a name?

7. Are the conclusions valid and recommendations justified? Are there competing conclusions or recommendations that should be considered?

8. Taken overall, is the manuscript in your opinion appropriate for publication as a *DFO Research Document:*

a) As it stands or with minor revision?
b) Only if modified substantially along the lines proposed?
c) Not at all?

November 25, 1998

Review Panel

Name	Title	Affiliation	Status
Angus, Randy	Manager	Cardigan Fish Hatchery / Cardigan, PEI	co-author paper 1
Bradford, Rod	Assessment Biologist	DFO, Science / Halifax, NS	Convenor senior author paper 2, 3 and 7 co-author paper 1 referee paper 4
Cairns, David	Assessment Biologist	DFO, Science / Charlottetown, PEI	Convenor senior author paper 1 co-author paper 3 referee paper 2
Chaput, Gérald	Assessment Biologist	DFO, Science / Moncton, NB	co-author paper 2 referee paper 6
Courtenay, Simon	Research Scientist	DFO, Science / Moncton, NB	co-author paper 4 referee paper 6
Groman, Dave	Adjunct Professor of Fish Health	Atlantic Veterinary College, University of Prince Edward Island / Charlottetown, PEI	referee paper 1
Hambrook, Mark	Manager	Miramichi Fish Hatchery / Miramichi, NB	co-author paper 1
Hammell, Larry	Professor	Dept. Health Management, University of Prince Edward Island / Charlottetown, PEI	referee paper 5
Harrell, Reginal	Professor	University of Maryland / Maryland, USA	senior author paper 5 referee paper 7
Hutchings, Jeff	Professor	Dalhousie University / Halifax, NS	co-author paper 7 referee paper 5
Jessop, Brian	Assessment Biologist	DFO, Science / Halifax, NS	co-author paper 3 referee paper 2
Klassen, Greg	Research Scientist	Tau Biodiversity / Memramcook, NB	
Meerburg, Dave	Policy Advisor, Diadromous Fishes	DFO, Science / Ottawa, ON	Chair
Peterson, Richard	Research Scientist	DFO, Science / St. Andrews, NB	co-author paper 1 referee paper 4

Name	Title	Affiliation	Status
Ritter, John	Manager, Diadromous Fish Division	DFO, Science / Halifax, NS	referee paper 10
Robichaud-LeBlanc, Kim	Biologist	DFO, Science / Halifax, NS	Convenor referee paper 3
Robinson, Mike	Masters Student	University of New Brunswick / Fredericton, NB	senior author paper 4
Rulifson, Roger	Director, Field Station for Coastal Studies at Mattamuskeet	East Carolina University / North Carolina, USA	senior author paper 6 referee paper 7
Stevens, Greg	Senior Advisor, Fisheries Management	DFO, Science / Halifax, NS	senior author paper 10
Wheaton, Fred	Chairman Fisheries Committee	New Brunswick Wildlife Federation / Moncton, NB	referee paper 3

Meeting Schedule (Agenda)

Wednesday, December 9

AM 8:00
- Introduction and Orientation (*Meerburg*)
- Brief summary of salmon aquaculture impact Workshop (*Ritter*)
- Interpretation and legal basis of existing conventions (*Dunn*)
- Coffee Break
- Description of aquaculture industry (*Cairns*)
- Stock status in southern Gulf (*Bradford*)
- Lunch

PM 1:30
- Stock status in the Maritime provinces (*Bradford*)
- Aquaculture breeding programs (*Harrell*)
- Coffee Break
- Stocking programs in the US (*Rulifson*)
- Sum up

Thursday, December 10

AM 8:30
- Housekeeping Remarks
- Genetic investigations (*Robinson and Courtenay*)
- Coffee
- Potential for genetic risks (*Bradford and Hutchings*)
- Overview of striped bass parasitology (*Hogans*)
- Lunch

PM 12:30
- Potential ecological effects and fish disease impacts
- Mitigative measures to avoid or minimize potential harmful effects
- Coffee
- Future research to ensure protection of wild stocks
- Management considerations to safeguard the wild stocks
- Closing comments

Friday, December 11

AM 8:30
- Housekeeping Remarks
- Report review

Workshop Terms of Reference
Sponsored by the Diadromous Subcommittee of
the Regional Assessment Process (RAP)

REMIT / QUESTIONS

- **Are artificially-reared striped bass interacting with wild striped bass in the Maritimes Region?**
- **If so, what are the potential impacts on the wild striped bass stocks in the Maritimes Region?**
- **What should be done to eliminate or minimize these impacts?**

OBJECTIVES

Aquaculture-Related

- To assess the potential impact of artificially reared striped bass escapees on wild striped bass stocks in the Maritime Provinces.
- To assess the benefits and risks associated with the use of wild fish versus domesticated broodstock as a means to supply the annual requirements of a striped bass aquaculture industry.
- To outline potential measures to reduce risk of harmful effects of cultured striped bass on the conservation and genetic integrity of the wild striped bass stocks.
- To determine the adequacy of current DFO policy on striped bass Introductions, Transfers and Broodstock Collection.
- To recommend research activities required to understand the nature and scale of potential impacts of aquaculture escapees and to mitigate such impacts.

Enhancement/Restoration-Related

- To assess the potential benefits and risks associated with the enhancement of existing populations and/or the restoration of extirpated Maritime populations with artificially reared striped bass.

- To assess the potential benefits and risks of enhancing production from existing Maritimes Region populations by artificially reducing the loss of natural production due to winter mortality.

- To define the guiding principles for enhancement of existing populations and/or the restoration of known extirpated populations in the Maritimes Region.

- To recommend research activities required to assess the viability and likelihood of success of striped bass enhancement and restoration programs (all methods).

ISSUES TO CONSIDER

- ***Definition of the scope of the RAP:***
  - RAP will be concerned with striped bass in the Maritime Provinces, including fish which spawn elsewhere but which undertake seasonal visits to the Maritimes. Information from other regions will be considered where it is germane to the Maritimes situation;
  - artificially reared striped bass include fish cultured for any purpose, including commercial aquaculture, enhancement of wild populations, and restoration of extirpated populations;
  - wild striped bass refer to self-sustaining populations of striped bass in eastern Canadian rivers; they do not include migrants from populations extant to the estuaries of the eastern seaboard of the United States;
  - broodstock are breeding adult fish, either wild or domesticated;
  - aquaculture striped bass includes any broodstock, eggs, larvae, juveniles and market-sized fish held or reared in captivity;
  - biological zone refers to the known natural range of extant populations in the Maritimes (presently separated into the southern Gulf of St. Lawrence and the Bay of Fundy-Scotian Shelf).

- ***Extent of current striped bass aquaculture in the Maritime Provinces including:***
  - description of aquaculture activities (freshwater and marine operations), products and intended markets (including destinations);
  - mapping of aquaculture sites overlain with known wild-spawning sites;
  - history of operations (when farming started by location and sector);
  - size of operations;
  - patterns of escapes (numbers, locations) to the extent known;
  - origin of stocks used (by river and biological zone and certainty of their river of origin);
  - utilization of Maritimes Region striped bass in selective breeding programs for aquaculture broodstock development.

- ***Status of wild striped bass stocks in the biological zones where aquaculture activities have occurred, now occur, or have been proposed to occur:***
  - current levels relative to conservation requirements;
  - acceptability of current (provisional) conservation requirements as a basis to appraise risk to wild populations;
  - potential and/or recent production levels, with comparison to potential magnitude of cultured biomass of striped bass;
  - description of stocks in terms of numbers of stocks, genetic uniqueness, stocking history, etc.

- ***Evidence and/or conceivable mechanisms of interaction:***
  - genetic effects (e.g. introgression, intrinsic growth rates and consequences for winter survival);
  - fish disease (including parasites) effects;
  - ecological effects (loss of habitat, exposure to artificial feeds and medications).

- ***Regulatory environment:***
  - Acts, regulations, and policies administered by the Department of Fisheries and Oceans, Environment Canada, and provincial governments.

- ***Mitigative measures - aquaculture:***
  - measures that industry might implement for containment of farmed fish or to prevent interaction with wild stocks (include consequences of mitigative measures on aquaculture production performance, e.g., triploidy);
  - measures that government might implement to reduce risk of harmful interactions between aquaculture and wild stocks while not constraining the economic viability of the aquaculture industry;
  - Is zero escapement a realistic objective for seacage culture? If not, what alternate methods are available?

- ***Measures required to ensure that enhancement benefits wild populations*:**
  - identify natural constraints on wild production and design release schedules of artificially reared fish to safeguard against the relaxation of natural selective forces that might reduce the genetic fitness of wild populations.

- ***Measures required to ensure that restoration of extirpated populations does not negatively affect extant populations within the same biological zone*:**
  - how well is the stock structure of wild striped bass resolved, how might straying by stocked fish interfere with wild production elsewhere.

- ***Outstanding Research (what needs to be done and at what cost):***
  - defining the nature of potential interactions and their effects;
  - establish preventative measures and policy;

- define responsibilities of government and industry in filling knowledge gaps in biology, ecology, and population dynamics of wild striped bass, while in the early stages of industry development; identify where cooperative research would yield maximum benefits to both resource conservation and industry development.

QUESTIONS, CONTRIBUTED PAPER OUTLINES, WRITING ASSIGNMENTS

1. What is the extent of the striped bass aquaculture industry in the Maritime Provinces?

Paper 1 (WP98-101): Striped bass aquaculture in eastern Canada: past, present, and future, by David Cairns, Rod Bradford, Kimberly Robichaud-LeBlanc, Richard Peterson, and Randy Angus, (*refereed by Bill Hogans and David Groman*).

Paper to include:

- Reasons for and extent of interest in striped bass culture in eastern Canada;
- Location, history, size, origin and fate of fish used, of research, display, and commercial culture operations in eastern Canada;
- Reasons why eastern Canadian industry remains small, and scope for expansion;
- Advantages and disadvantages of culture operations for wild stock conservation;
- Discussion of escapement risk and consequencies, and means to reduce risk to wild populations.

2. What baseline information is available for the biology, ecology and population dynamics of wild populations where aquaculture is now practiced or is planned?

Paper 2 (WP98-102): Status of striped bass (*Morone saxatilis*) in the Gulf of St. Lawrence in 1998, by Rod Bradford, Gérald Chaput, Scott Douglas, and John Hayward, (*refereed by Brian Jessop and David Cairns*).

Paper to include:

- Introduction (stock structure, recent assessment history, resource utilization, 1997 forecasts for 1998, study area)
- Description of fisheries (commercial, recreational, First Nation's harvest)
- Conservation requirements
- Estimation of stock parameters (1998 spawner abundance, mark-recapture, indices of abundance, spawner success)
- Monitoring for change in the geographic distribution of spawning activity: Fishing mortality under conservation management
- Results
  - Spawner abundance estimates
  - Trends in spawner abundance
  - Spawner success
  - Juvenile mortality

- Monitoring for change in the geographic distribution of spawning activity: Estimates of fishing mortality
- Forecast/Prospects
- Ecological considerations
- Management considerations
- Research recommendations for 1999

Paper 3 (WP98-103): Update on the status of striped bass (*Morone saxatilis*) in Eastern Canada in 1998, by Rod Bradford, David Cairns, and Brian Jessop, (*refereed by Fred Wheaton and Kimberly Robichaud-LeBlanc*).

Paper to include:

- Introduction
- Spawning populations in Canadian waters
- Inferred / suspected populations
- Current status of spawning populations in Canadian waters
- Factors contributing to extirpation
- Management considerations
- Ecological considerations
- Research recommendations for 1999

Paper 4 (WP98-104): Genetic investigations on striped bass in the Maritime Provinces, by Mike Robinson and Simon Courtenay, (*refereed by Richard Peterson and Rodney Bradford*).

Paper to include:

- Brief overview of genetic techniques in fisheries;
- Summary of RFLP and microsatellite techniques (strengths and weaknesses) 1990-91 RFLP analyses of Tabusintac, Miramichi, Shubenacadie vs Hudson R., Chesapeake Bay;
- Mixing of US and Shubenacadie fish in the Bay of Fundy. Clarification and limitations of analysis 1997-98 nuclear analyses of Miramichi, Shubenacadie and young of the year migrants caught in transit between Miramichi and Richibucto or Kouchibouguac. Implications of observed migration of young of the year;
- Conclusions/discussion
  - Distinction of southern Gulf of St. Lawrence and Bay of Fundy;
  - Likelihood of multiple populations within southern Gulf of St. Lawrence;
  - The next step-resolving present uncertainties (temporal stability in genotype signature: RFLP vs nuclear techniques);
  - Other areas of spawning that may or may not be genetically distinct (e.g. SW Miramichi, Tabusintac, Richibucto, Kouchibouguac);
  - Survival and subsequent contribution of young of the year migrants.

3. What evidence exists that artificially reared fish can interact with wild striped bass, what form do these interactions take, and are there known consequences?

<u>Paper 5 (WP98-105):</u> Overview of striped bass aquaculture breeding programs and review of studies conducted on the interaction between aquaculture escapees and wild striped bass in the United States, by Reginal Harrell, (*refereed by Larry Hammell and Jeff Hutchings*).

Paper to include: (not available).

<u>Paper 6 (WP98-106):</u> Striped bass stocking programs in the United States: ecological and resource management issues, by Roger Rulifson and R. Wilson Laney, (*refereed by Gérald Chaput and Simon Courtenay*).

Paper to include:

- Historical perspective on striped bass importance, reasons for decline and alternative ways to reverse trends;
- Rationale for stocking programs;
- Issues:
  - Does stock enhancement work?;
  - What should be used as broodstock?;
  - Genetics (bottlenecking, cross-stocking, ecological compatibility, sampling protocols);
- Stocking practices: early, present and federal regulatory changes;
- Management implications:
  - Re-examination of current stocking practices;
  - What contribution are hatchery fish now making to 'restored stocks'?;
  - Mixed stock analyses for ocean harvest;
- Law enforcement problems tracking illegally harvested fish;
- Ecological implications:
  - Gene pool conservation of the species;
  - Is there such a thing as stock integrity? - discrete stocks?;
  - Homing versus wandering;
  - Environmental compatibility of genetic strains to watersheds targeted for restoration;
- Conclusions and recommendations: Enhancement and restoration.

4. What are the potential impacts of artificially reared striped bass released to the wild on wild striped bass stocks?

Paper 7 (WP98-107) : Potential for genetic risks to wild striped bass stocks from artificially reared striped bass operations, by Rod Bradford and Jeffery Hutchings, (*refereed by Simon Courtenay and Roger Rulifson*).

Paper to include:

- Introduction (relevant life history attributes of northern striped bass, issues and concerns, scope and objectives);
- Inter-annual variability in realized growth;
- Environmental determinants of pre-winter body-size (development and application of a temperature-and body-size-specific growth model for northern striped bass);
- Genetic risks associated with escapement and subsequent interbreeding between wild and artificially-reared striped bass;
- Conclusions and recommendations (in light of aquaculture, stock enhancement and stock restoration activities).

Paper 8 (WP98-108): A review of potential impacts on wild striped bass stocks from fish diseases attributed to artificially reared striped bass operations (author to be confirmed).

[CANCELLED]

Paper 9 (WP98-109): Parasites and diseases of cultured and wild striped bass: review of current knowledge, by William Hogans, (*refereed by Sharon McGladdery and Greg Klassen*).

Paper to include:

- Review of parasites of wild and cultured striped bass
- Assessment of risk of transmission of parasites and disease between cultured and wild populations
- Pathogenicity of parasites in wild and cultured striped bass populations
- Treatment methodologies for parasites and diseases of cultured striped bass
- Environmental factors influencing epidemic occurrences of diseases in cultured striped bass.

[CANCELLED]

5. What existing conventions exist that potentially influence or constrain DFO's ability to regulate the artificial rearing of striped bass (all purposes) relative to striped bass conservation in the Maritime Provinces?

Paper 10 (WP98-110): Interpretation and legal basis of existing conventions pertaining to wild fisheries enhancement and/or restoration, and control and minimization of aquaculture impacts on wild striped bass stocks, by Dave Dunn, Greg Stevens, and Jim Jenkins, (*referced by John Ritter*).

Paper to include:

- Legislative responsibilities and administrative roles
  - Aquaculture
  - Wild fisheries
- Fish health issues
  - Introductions
  - Transfers

REVIEW PROCESS

The format for the review centers around one and a half hour being assigned to each of the formal papers. That hour and a half will be divided into fifteen minute segments for presentation of the paper, comments from the first referee, comments from the second referee, comments from the scientific review panel, and comments and questions from the attendees at large. A few minutes of the final fifteen minutes will be used for summing-up as well. This format will be adhered to by necessity in order to complete the lengthy agenda.

Products

- Fisheries Status Report on this issue.
- Supporting Research Documents (upgrading of all Working Papers presented)
- Meeting Proceedings

Products will provide answers/guidelines to the following:

- What are the potential ecological effects related to the presence of artificially reared fish at large and of striped bass aquaculture operations on wild striped bass?

- What are the potential impacts on wild striped bass stocks from fish diseases attributed to artificially reared striped bass operations?

- What mitigative measures would be feasible, if required, to contain artificially reared (and selected)-for-aquaculture striped bass and avoid or minimize potential harmful effects of the striped bass aquaculture industry on wild striped bass stocks?

- What research needs to be done to ensure that aquaculture, enhancement and restoration could proceed without posing a threat to the viability of existing wild striped bass stocks?

- What artificial rearing activities could be permitted while the outstanding research issues are investigated?

- What management considerations are required to safeguard wild striped bass stocks?

ARRANGEMENTS

Location and Date

Gulf Fisheries Center, Moncton, New Brunswick,
December 9 - 11, 1998

Convenors

- Rodney Bradford
- David Cairns
- Kimberly Robichaud-LeBlanc

Chairperson

- David Meerburg, Policy Advisor, Anadromous and Catadromous Fishes, DFO, Ottawa

Media Spokespersons

- David Meerburg
- John Ritter

Review Panel

Limited to the authors and referees of the formal papers and other individuals essential to the peer review (i.e., rapporteurs, and scientific experts)

Observers

Meeting open to everyone, including media. Special invitations sent to the following:

Department of Canadian Heritage
- Kouchibouguac National Park

Provinces
- NB DFA and NB DNRE
- NS DoF (both Aquaculture and Inland Fisheries Divisions)
- PEI Department of Fisheries and Environment (both Aquaculture and Fish and Wildlife Divisions)

Industry

- Recreational Fishing/Watershed Stewardship Groups (New Brunswick Wildlife Federation, Miramichi Watershed Management Committee, Miramichi River Environmental Assessment Committee, PEI Wildlife Federation, Nova Scotia Wildlife Federation)
- First Nations and Councils
- Aquaculture Association of Nova Scotia
- NB Conservation Council, Nova Scotia Ecology Action Center

REMIT / QUESTIONS

Remit / Question

- **Are artificially-reared striped bass interacting with wild striped bass in the Maritimes Region?**
- **If so, what are the potential impacts on the wild striped bass stocks in the Maritimes Region?**
- **What should be done to eliminate or minimize these impacts?**

PAPERS

Paper Numbers	Paper Titles	Authors	Rapporteurs	Referees
Paper 1 (WP98-101)	Striped bass aquaculture in eastern Canada: past, present and future	Cairns, David; Robichaud-LeBlanc, Kimberley; Bradford, Rodney; Peterson, Richard; Angus, Randy	Courtenay, Simon C.	Hoganbs, Bill and Groman, David
Paper 2 (WP98-102)	Status of striped bass *(Morone saxatilis)* in the Gulf of St. Lawrence in 1998	Bradford, Rodney; Chaput, Gérald; Douglas, Scott; and Hayward, John	Peterson, Dick	Jessop, Brian and Cairns, David
Paper 3 (WP98-103)	Update on the status of striped bass *(Morone saxatilis)* in Eastern Canada in 1998	Bradford, Rodney; Cairns, David; and Jessop, Brian	Chaput, Gérald	Peterson, Richard and Bradford, Rodney
Paper 4 (WP98-104)	Genetic investigations on striped bass *(Morone Saxatilis)* in the Canadian Maritime Provinces	Robinson, Mike; and Courtenay, Simon C.	Hutchings, Jeff	Peterson, Richard; and Bradford, Rodney
Paper 5 (WP98-105)	Overview of striped bass aquaculture breeding programs and review of studies conducted on the interaction between aquaculture escapees and wild striped bass in the United States	Harrell, Reginal	Bradford, Rodney Cancelled	Hammell, Larry and Hutchings, Jeff
Paper 6 (WP98-106)	Striped bass stocking programs in the United States: Ecological and Resource Management Issues	Rulifson, Roger A. and Laney, Wilson R.	Robichaud-LeBlanc, Kim	Chaput, Gérald and Courtenay, Simon
Paper 7 (WP98-107)	Genetic interaction between artificially-reared and wild Canadian striped bass *(Morone*	Bradford, Rodney and Hutchings,	Cairns, David	Harrell, Reginal and Rulifson,

Paper Numbers	Paper Titles	Authors	Rapporteurs	Referees
	saxatilis): Risks and Uncertainties	Jeffery		Roger
Paper 8 (WP98-108)	A review of potential impacts on wild stried bass stocks from fish diseases attributed to artificially reared striped bass operations	**[CANCELLED]**		
Paper 9 (WP98-109)	Parasites and diseases of cultured and wild striped bass: review of current knowledge	**[CANCELLED]**		
Paper 10 (WP98-110)	Striped bass in the Maritime Provinces: the regulatory environment	Stevens, Greg; Dunn, Dave; and Jenkins, James B.	Jessop, Brian	Ritter, John

List of Recommendations

STRIPED BASS AQUACULTURE IN EASTERN CANADA: PAST, PRESENT, AND FUTURE

Working Paper(s): WP 98-101 – Paper 1

Recommendations taken from Rapporteur Report

- **Research Recommendation**

1. Reliable information on striped bass transfers and escapes is necessary for development of strains suitable for aquaculture, to evaluate potential alteration of the genetic make-up of wild stocks through interbreeding of escapees and wild fish, and to trace potential routes of disease transmission. It is recommended that a system be established to record and archive such information for eastern Canada as a pilot before implementing it with salmonids.

- **Management Consideration**

1. A data-gathering system be put in place that systematically records all transfers of striped bass genetic material, including milt, eggs, larvae, juveniles, and adults, within eastern Canada and between eastern Canada and other areas. The system should record the dates, numbers, life stages, health status, providing facilities, genetic origins, and destinations of transfers. Transfers between culture and the wild state, both intentional and accidental (escapes) would be considered transfers.

2. This system should record data in permanent archives, in a manner analogous to fishery landing statistics. The system should have clear rules regarding confidentiality and public disclosure of data.

3. If some part of this system is operated by provincial authorities, then data gathering and archiving should be set up under common protocols so that inter-provincial transfers, and releases or escapes of fish that might later cross provincial boundaries, can be readily traced.

Recommendations taken from Paper:

1. It is recommended that a data-gathering system be put in place that systematically records all transfers of striped bass genetic material, including milt, eggs, larvae, juveniles, and adults, within eastern Canada and between eastern Canada and other areas. The system should record the dates, numbers, life stages, health status, providing facilities, genetic origins, and destinations of transfers. Transfers between culture and the wild state, both intentional and accidental (escapes) would be considered transfers.

2. This system should record data in permanent archives, in a manner analogous to fishery landing statistics. The system should have clear rules regarding confidentiality and public disclosure of data. Confidentiality of private operations should be respected where appropriate, but in cases where the interest of private confidentiality conflicts with a broader public interest for information release (safeguarding of wild stocks and fish held in other aquaculture facilities), then the public interest will prevail.

3. If some part of this system is operated by provincial authorities, then data gathering and archiving should be set up under common protocols so that inter-provincial transfers, and releases or escapes of fish that might later cross provincial boundaries, can be readily traced.

STATUS OF STRIPED BASS *(MORONE SAXATILIS)* IN THE GULF OF ST. LAWRENCE IN 1998

Working Paper(s): WP98-102 – Paper 2

Recommendations taken from Rapporteur Report

- **Research Recommendation**

1. Again there were no specific recommendations, but more thorough investigation of other possible spawning areas seemed appropriate.

Recommendations taken from Paper

Research recommendations for 1999

Repeat Miramichi Sampling, Mark-Recapture Experiments: May-June, 1999

Objectives:
1) estimate spawner abundance for 1999,
2) estimate the strength of the 1996 year-class (age 3^+ males),
3) complete age-growth studies for the years 1993-1999 in order generate age-length keys that will allow for estimation of recruitment for each spawning year.

Sample Miramichi Smelt Bycatch: October-December, 1999
Objectives:
1) continue the assessment of striped bass spawning success in the Miramichi in 1999 given the expectation that female abundance will not meet conservation requirements.
2) acquire pre-winter estimates of size at age for continuation of winter mortality studies.

Size-dependent Winter Survival
Objectives:
1) Extend the back-calculation analysis to the 1994 to 1997 year-classes to determine if size-selective mortality contributed to the apparently low survival of the 1995 year-class.

UPDATE ON THE STATUS OF STRIPED BASS *(MORONE SAXATILIS)* IN EASTERN CANADA IN 1998

Working Paper(s): WP98-103 – Paper 3

Recommendations taken from Rapporteur Report

- **Research Recommendation**

1. Resolve stock status of striped bass on Prince Edward Island.
2. Conduct stock assessment of the Shubenacadie River striped bass.
3. Address Nictaux River hydroelectric generation and pH depression on Annapolis River.
4. Study dynamics of water drawdown at Mactaquac and impact on spawning habitat.

- **Management Consideration**

1. Two of the three known extirpations of striped bass from Canadian waters have occurred in the Maritimes. The overall loss of production from these extirpations is not known because abundance estimates have only been obtained for one stock (Miramichi). It is not known if losses represent a significant loss of genetic diversity.
2. Until demonstrated otherwise, striped bass management at the regional level should proceed on the basis that there are only two self-sustaining populations in the Maritimes.
3. Sufficient information is available for Miramichi River bass to assist in the control of bycatch in commercial fisheries.
4. Sufficient informaton has been acquired about spawning, rearing and overwinter habitat of Miramichi striped bass to be included in terms of reference for environmental impact assessments.

Recommendations taken from Paper

Research recommendations for 1999

Resolve stock status of Striped Bass on Prince Edward Island (May, 1999-June, 2000)
In collaboration with client groups;
1. Mark-recapture experiments and biological sampling of adult and sub-adult striped bass captured in the Hillsborough River (May-June, 1999).

2. Search for recaptures of striped bass among the bycatch from Hillsborough River boxnet gaspereau fishery (May-June 2000).
3. Systematic beach seine surveys of Hillsborough River to establish presence/absence of young-of-the-year (July-October, 1999).
4. Establish linkages with southern Gulf of St. Lawrence striped bass program. Search for recaptures on the NW Miramichi of striped bass marked and released on the Hillsborough River (May-June, 1999, 2000).

Stock assessment of Shubenacadie River striped bass (May-November, 1999)

1. Mark adult and age 2^{+} juvenile striped bass during spring April-May downstream migration from Shubenacadie Lake.
2. Recapture striped bass during a) the downstream migration to estimate size of the wintering adult and juvenile populations, and b) as spawning adults captured incidentally in the April-June drift gillnet fisheries for gaspereau and American shad on the Stewiacke-Shubenacadie estuary to estimate spawner abundance.
3. Systematic beach seine survey of Shubenacadie estuary to collect young-of-the-year striped bass for growth studies and possible development of indices of spawner success.
4. Continue collections of pre-winter young-of-the-year striped bass for studies on winter mortality and recruitment.

Nictaux River hydroelectric generation and pH depression on the Annapolis River

1. Monitor pH (and labile aluminium) on the Annapolis River at three sites; upstream of confluence with Nictaux River, at the confluence, and downstream of the confluence on the spawning grounds.

Dynamics of water drawdown at Mactaquac and impact on spawning habitat

1. Acquire and analyze data on seasonal discharge and temperature of river flows prior to construction of the Mactaquac Dam as compared with after dam construction.

GENETIC INVESTIGATIONS ON STRIPED BASS IN THE MARITIME PROVINCES

Working Paper(s): WP98-104 – Paper 4

Recommendations taken from Rapporteur Report

- **Research Recommendations**

1. Ichthyoplankton and beach seine surveys should be conducted to quantify the abundance of striped bass eggs and larvae in those rivers in the southern Gulf and Bay of Fundy suspected of containing habitat suitable for striped bass reproduction and rearing of juveniles.

GENETIC INVESTIGATIONS ON STRIPED BASS IN THE MARITIME PROVINCES

Working Paper(s): WP98-104 – Paper 4

2. Nuclear DNA studies should be continued to assess population differentiation among known and suspected striped bass populations in eastern Canada.
3. Nuclear DNA data should be coupled with mtDNA restriction fragment length pattern (RFLP) data to assess the validity of conclusions based on previous mtDNA studies.
4. Genetic analyses should be conducted to quantify the temporal stability of genetic variation in known or suspected striped bass populations.
5. Undertake genetic studies to study the phylogeography of striped bass.

Recommendations taken from Paper:

In our opinion, the following three recommendations for future research should be considered to help us better understand the population dynamics of striped bass in Canadian waters.

1. First, exactly which rivers in the southern Gulf of St. Lawrence and Bay of Fundy support striped bass spawning? The only way to determine this is through ichthyoplankton surveys to selectively capture eggs and larvae of striped bass. Young striped bass in the southern Gulf of St. Lawrence are capable of substantial movement, thereby negating their usefulness as indicators of spawning activity.

2. Second, nuclear DNA studies should be continued in an effort to examine both the population structure of striped bass in eastern Canada and their relative levels of genetic differentiation.

Third, nuclear DNA data should be coupled with mtDNA RFLP data to validate previous mtDNA studies and to see if genotype signatures in striped bass (nuclear DNA and mtDNA) are stable over time.

We are not suggesting by this paper that we need to jump onto any DNA bandwagon to save our stripers. However, most of us know that good fisheries management and good fisheries science often go hand in hand. Continued work on the genetics of striped bass in our area is paramount if a management plan is to be both efficient and effective. By better understanding bass populations in the Maritimes today, we will increase our chances of better protecting our striped bass populations of tomorrow.

OVERVIEW OF STRIPED BASS AQUACULTURE BREEDING PROGRAMS AND REVIEW OF STUDIES CONDUCTED ON THE INTERACTION BETWEEN AQUACULTURE ESCAPEES AND WILD STRIPED BASS IN THE UNITED STATES.

Working Paper(s): WP98-105 – Paper 5

Recommendations taken from Rapporteur Report

- **Research Recommendation**

1. Genetic discreteness of the wild Canadian striped bass stocks should be confirmed through investigations on nuclear DNA.

- **Management Consideration**

1. Intentional releases of cultured striped bass into the wild for the purpose of recreational fishery enhancement should not proceed where 'genetically pure' strains of wild striped bass exist; i.e., no prior stocking history or risk of interaction.
2. Activities related to the commercial aquaculture of striped bass where 'genetically pure' strains of wild striped bass exist should be conducted in a fashion that precludes risk of introgression between wild and cultured striped bass.

STRIPED BAS STOCKING PROGRAMS IN THE UNITED STATES: ECOLOGICAL AND RESOURCE MANAGEMENT ISSUES

Working Paper(s): Paper 6 (WP98-106) - Paper 6

Recommendations taken from Rapporteur Report

- **Research Recommendation**

1. Research marking techniques which could be used to track wild fish.

- **Management Consideration**

1. Population should be managed conservatively with respect to maintaining genetic diversity, sustainability and ecological functions.

2. Our (conserative) view is to impose sufficient regulatory measures to ensure adequate protection
3. If stock enhancement is selected, adopt measures recommended by Upton (1996) regarding
    - disease considerations
    - tagging programs
    - restoration criteria
    - genetic and hybrid concerns
    - stocking strategies
    - provincial coordination
    - evaluation

Recommendations taken from Paper:

Conclusions and Recommendations

Based on review of the literature that addresses existing migratory striped bass stock enhancement programs in the United States, as well as the broader review of marine stock enhancement issues prepared by Grimes (1998), it is apparent that there is no definitive answer at this time with regard to the effectiveness, from either an ecological or economic perspective, of such stock enhancement efforts. Definitive answers await further rigorous testing using sound scientific design. In the interim, management of striped bass populations should be conducted conservatively with a view toward maintaining present genetic diversity, sustainability and ecological function.

Recommendations on Enhancement.
We generally concur with the conclusion of Upton and Mangold (1996) that "...stocking solely for the purpose of put-and-take fisheries is not advisable given the current success and relatively low costs of wild fishery management." Grimes (1996) reaches essentially the same conclusion that the desirability of marine stock enhancement as a management tool "...must be weighed against far-less-expensive, but more politically difficult, traditional approaches...." In our view, the conservative approach for enhancement of wild, endemic stocks is to impose sufficient regulatory measures to ensure adequate protection, conservation and sustainability for future generations.

Should stock enhancement be chosen as a management measure in the face of documented uncertainties, then we strongly recommend a thorough review and adoption of the measures recommended in Upton (1996). That report finalizes recommendations which should be incorporated into any migratory striped bass stocking program. The recommendations pertain to seven major areas and are repeated here in their entirety, with minor editing to reflect application to Canadian stocks:

1) Disease considerations:

- Striped bass tested and proven to be carriers of the IPN virus should not be stocked into natural waters and especially not into waters with salmonids.
- To reduce the spread of disease, when striped bass are to be stocked or transported into provinces which culture salmonids, these fish should be screened for IPN and other pathogens. It is incumbent upon potential striped bass shippers to be aware of each province's policies and regulations on disease screening prior to shipping to that province.
- Provinces receiving striped bass may require screening for pathogens. Screening requirements and authorization to ship fish is the prerogative of the receiving province.
- Provinces should report shipping and disease screening requirements for striped bass to the DFO so that this information can be readily disseminated.
- Additional research is needed on the potential of disease transfer among striped bass, other anadromous species, and warmwater species.

2) Tagging programs:

- If fish are to be stocked in coastal waters, a sufficient number must be marked to allow determination of survival and percentage of contribution to natural (endemic) stocks. All fish should be marked in cases where hatchery-reared striped bass could confound juvenile survey indices.
- All fish should be marked if one million or less are stocked.
- If more than one million are to be stocked, then the percentage to be marked should be calculated based on the number of fish released and the estimated number in the natural (endemic) stock.
- Binary coded wire tags should be used to mark fingerlings to be released in all coastal waters. Other tagging methods which also differentiate release sites and date might be substituted under certain circumstances.
- Binary coded wire tag codes should contain information sufficient to identify each lot of fish stocked.
- Under certain circumstances hatchery fish of sufficient size should be marked with tags recognizable to fishermen so that individuals may report recoveries.

3) Recommendations on Restoration. From Upton (1996), the following recommendations are offered:

- Continue to evaluate the return of adult females to the spawning grounds for all studies in which significant numbers of hatchery fish were marked.
- Continue research concerning larval and juvenile mortality and abundance for improved understanding of factors affecting recruitment and possible calibration of juvenile indices.
- Any stocking for enhancement purposes should be terminated except in those systems where striped bass have been absent or when the adult population and reproduction have been at low levels for several years as measured by juvenile and spawning surveys.
- Continue to survey recreational and commercial fisheries in order to quantify benefits of stocking programs to both pre-migratory and coastal populations.
- Stocking of hatchery-reared fish should be recognized as only one tool available to resource managers and the appropriateness of this tool will vary with circumstances.
- Stocking should be at the discretion of the province in cases where agreements between power companies and a given state are in effect (for mitigation of impingement/entrainment impacts).

4) Genetic and hybrid concerns:

- Genetic integrity of Atlantic Coast striped bass should be maintained within river basins, including specific rivers of bays and estuaries.
- Only progeny from endemic brood stock, when available, should be stocked in river basins and coastal waters.
- Progeny from brood stock of adjacent rivers or hydrologically similar systems should be used if endemic brood stock do not exist. If non-endemic fish are to be stocked these activities should be reported to the DFO.
- Brood stock requirements such as the number of females needed for hatchery production from a specific system, detection of striped bass-hybrid backcrosses, and the use of hatchery-reared fish as brood stock should be further investigated, especially if any new stocking initiative is to take place. Interim policy dictates a conservative approach by using as many females as possible and avoiding the use of hatchery-reared females or males to prevent over-representation from a particular gene pool.
- Hybrids should be restricted to inland freshwater reservoirs or to other systems in which escapement and reproduction is not likely. Any inland reservoir stocking programs should

employ purebred strains of striped bass endemic to the river system being stocked.

- Neither striped bass nor hybrids should be stocked in coastal or inland waters without prior notification and approval of the proper and official provincial fishery agencies.

- Commercial aquaculture operators must understand that escapement of hybrids and non-endemic striped bass will not be allowed, and that concerned agencies should be alerted to this policy. Sterile fish should be used for aquaculture operations.

5) Stocking strategies:

- In areas with or without natural reproduction, phase I or phase II fish should be stocked as long as they are marked to avoid confounding young-of-year surveys.

- Juvenile and adult surveys should be continued to determine the most cost effective release strategies including age at release and optimal release conditions such as salinity, temperature, and time of day for future potential stocking programs.

6) Provincial coordination:

- Programs among and within provinces should be coordinated by adhering to recommendations made by a coordinating committee.

- Each province should take appropriate regulatory or statutory action to insure that striped bass stocked by private entities into coastal waters be in accordance with recommendations of the coordinating committee.

- Stocking and evaluation activities should be reported to the committee to allow for the dissemination of information to other interested parties.

7) Evaluation:

- The tagging program should be coordinated on a coast-wide basis in order to avoid duplication of tag codes, and to make sure that resources such as wand tag detectors are used to the fullest possible extent.

- A central database and archive for the binary coded wire tags and data should be maintained by the committee and the DFO so that standardization and sharing of data will be facilitated. This should allow for a flow of information among provincial and federal agencies, and interested parties.

- Binary coded wire tags should be placed only in the left operculum.

- Stocking strategies should be further investigated and evaluated in order to maximize benefits achieved through stocking.

- The purpose of stocking and planned evaluation must be documented before further stocking programs are initiated.

- The evaluation program should be budgeted at a value equal to the coast of the stocking program.

GENETIC INTERACTIONS BETWEEN ARTIFICIALLY REARED AND WILD CANADIAN STRIPED BASS *(MORONE SAXATILLIS)*: RISK AND UNCERTAINITIES

Working Paper(s): WP98-107 - Paper 7

Recommendations taken from Rapporteur Report

- **Management Consideration**

1. A precautionary approach to further developments in the artificial-rearing of striped bass in Canadian waters either for aquaculture, enhancement, or restocking is advised.

2. The development of a precautionary management strategy to address both intentional and unintentional releases to the wild of artificially reared striped bass should include an evaluation of risks associated with the release of fish at each life history stage.

3. Releases to the wild of any striped bass that have never been exposed to the natural culling processes in effect during the first winter should be prohibited until the role of growth in winter survivorship is fully understood. This policy would include placement of 'artificially wintered' striped bass in grow-out facilities where there is a risk of escapement.

4. In the short term, introductions and transfers of striped bass between biogeographic regions harbouring extant wild populations of striped bass is to be prohibited.

A REVIEW OF POTENTIAL IMPACTS ON WILD STRIPED BASS STOCKS FROM FISH DISEASES ATTRIBUTED TO ARTIFICIALLY REARED STRIPED BASS OPERATIONS

Working Paper(s): WP98-108 – Paper 8

[CANCELLED]

PARASITES AND DISEASES OF CULTURED AND WILD STRIPED BASS: REVIEW OF CURRENT KNOWLEDGE

Working Paper(s): WP98-109 - Paper 9

[CANCELLED]

STRIPED BASS IN THE MARITIME PROVINCES: THE REGULATORY ENVIRONMENT

Working Paper(s): WP98-110 - Paper 10

Recommendations taken from Rapporteur Report

- **Research Recommendation**

1. No research recommendations are made.

- **Management Consideration**

1. Establish Advisory Committees in the Gulf sector, by province or geographic area as necessary.